

Go-Lab Deliverable D6.6 Go-Lab user communities support framework and guidelines

Fani Stylianidou, Eleftheria Tsourlidaki

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Go-Lab

Global Online Science Labs for Inquiry Learning at School

Collaborative Project in European Union's Seventh Framework Programme

Grant Agreement no. 317601



Deliverable D6.6

Go-Lab user communities support framework and guidelines

Editors	Fani Stylianidou
	Eleftheria Tsourlidaki

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18	Institute of Accelerating Systems and Applications	IASA	Greece
19	Núcleo Interactivo de Astronomia	NUCLIO	Portugal
20	Cardiff University	CU	United Kingdom

Contributors

Name	Institution
Ton de Jong	UT
Matthias Heintz	ULEIC
Adrian Holzer	EPFL
Fani Stylianidou	EA
Eleftheria Tsourlidaki	EA

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Executive Summary

This document (Deliverable D6.6) aims to be the teacher help guide which will accompany and a classroom scenario handbook (Deliverable D1.5) on how to incorporate Go-Lab into the classroom, as is foreseen in the Go-Lab's Description of Work.

It is the outcome of Task 6.5. 'Go-Lab Users Guidelines (Guidelines and Supporting Materials for Teachers)' and accordingly aims to:

- provide easy step-by-step guides for the use of the Go-Lab Portal and its main components;
- present the philosophy of the search mechanism and the main characteristics of the Go-Lab inventory of online labs;
- provide an easy step-by-step guide of how teachers can build their own Inquiry Learning Spaces (ILSs) to use in the science classroom;
- provide an a step-by-step guide for how teachers can access online support by expert and peer communities

The document will be available in conventional and electronic format (through the project's web site). It will be translated in 12 languages (English, French, German, Greek, Dutch, Spanish, Portuguese, Estonian, Bulgarian, Romanian, Italian, and Polish).

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1 Introduction

The Go-Lab project aims to address Europe's need for young people who are skillful and enthusiastic for science and regard science as their future career field, in order to guarantee competiveness and prosperity. To this end, and in line with the recommendations of the Rocard Report 'A new Pedagogy for the Future of Europe' (Rocard et al., 2007), that describes the basics for the introduction of the Inquiry Based approach in the science curricula of the Member States, Go-Lab has set as goals to encourage young students to:

- engage in science topics;
- acquire scientific inquiry skills; and
- experience the culture of doing science, under motivating circumstances, by undertaking active, guided, experimentation, carried out on more basic and top-level scientific facilities.

To achieve this, Go-Lab project offers:

- a federation of remote laboratories, virtual experiments, and data-sets (together referred to as "online labs"), organized in the Go-Lab portal;
- an authoring environment to embed these online labs in pedagogically structured learning spaces by teachers;
- online applications as cognitive scaffolds for students; and
- opportunities for social interaction.

Go-Lab's online labs are fit to be integrated into regular classroom activities. To facilitate this process, Go-Lab offers pedagogical methodologies and technical infrastructures to teachers:

- to guide the preparation of inquiry activities by the facility to compose dedicated learning spaces;
- to access resources that facilitate the design of realistic and engaging activities;
- to adopt, enrich, and/or modify these activities through an online community.

In its approach Go-Lab focuses on students in the age group of 10-18 covering late primary education, secondary education, and potentially the start of higher education. In this way it starts the engagement with science at an early stage which is considered to be an important preparation (Rocard, et al., 2007).

This document aims to work as a Teacher Guide and support science teachers in navigating through Go-Lab's methodology, tools and resources so as to create and deliver inquiry-based and technology-enhanced activities to use with students in their science classroom.

This chapter offers a brief introduction to the general aims of Go-Lab. Chapter 2 presents the theoretical background underpinning the development of the project; it describes what is currently known about inquiry learning and inquiry learning with simulations and remote and virtual labs, as well as how the Go-Lab project will bring the current state of knowledge a step further. Chapter 3 presents the Go-Lab portal; it is a step-by-step guide for teachers to facilitate their access and use of all the facilities offered by the portal. Chapter 4 presents the Go-Lab authoring environment; it is a step-by-step guide that helps teachers to build their own Inquiry Learning Spaces (ILSs) to use in the classroom. Finally, Chapter 5 presents the Go-Lab teacher support and communication facilities; it is a step-by-step guide for teachers to get support by expert and peer communities.

2 Go-Lab's theoretical framework

2.1 Background: About Inquiry Based Science Education [IBSE]

Understanding science is essential in today's society. The public's understanding of science is largely influenced by its experiences in science classrooms. It is therefore important that science teachers understand science and give an accurate representation of it in their classrooms. Science is defined as a body of knowledge, a process of inquiry, and the people involved in the scientific enterprise. Science teachers usually concentrate on the body of knowledge that forms their discipline. Students should also understand the process of scientific inquiry; the understanding should come through their experiences with the process in the science classroom and outside school. Few definitions of science include the people who are involved in the enterprise. Yet the history of science has proven, time and again, to be a history of scientists. Recognising the individual qualities important to scientists and guarding against human shortcomings that may also influence scientific work are necessary in presenting a total picture of science. Different models of scientific inquiry have been developed and extensively validated in recent years. The accumulation of valid reliable knowledge was shown to be the aim of all the models. Science teachers should understand the strengths and weaknesses, the procedures, and the logical problems of the different models of inquiry. In the science classroom there should be a balance in emphasis on science as a body of knowledge, a process, and a human enterprise.

The idea of teaching science by inquiry has a long history in science education. There is an equally long history of confusion about what teaching science by inquiry means and, regardless of the definition, its implementation in the classroom. Inquiry-based learning has been officially promoted as a pedagogy from improving science learning in many countries (Bybee et al., 2008; Hounsell & McCune, 2003; Minner et al., 2010), and since the publication of the 'Science Education Now: A renewed Pedagogy for the Future of Europe' report (Rocard et al., 2007) as one of the top educational goals for Europe (following similar actions in US by the National Research Council, 1996, 2000; Education Development Center, Center for Science Education, 2007).

'Inquiry' is referred to in the science education literature to designate at least three distinct but interlinked categories of activity: what scientists do (investigating scientific phenomena by using scientific methods in order to explain aspects of the physical world); how students learn (by pursuing scientific questions and engaging in scientific experiments by emulating the practices and processes used by scientists); and a pedagogy, or teaching strategy, adopted by science teachers (designing and facilitating learning activities that allow students to observe, experiment and review what is known in light of evidence) (Minner et al., 2010). This polysemy of the term explains partly the confusion associated with the implementation of 'inquiry-based science education' (IBSE), a term in itself used as an umbrella for various educational approaches, characterized by the differing emphasis they put on these three distinct 'inquiry' activities.

For example, Linn et al.'s (2004) definition of inquiry as

"the intentional process of diagnosing problems, critiquing experiments, and distinguishing alternatives, planning investigations, researching conjectures, searching for information, constructing models, debating with peers, and forming coherent arguments". (p4)

seems to put the emphasis on what scientists do, whereas the US National Research Council's definition as

"a set of interrelated processes by which scientists and students pose questions about the natural world and investigate phenomena; in doing so, students acquire knowledge and

develop a rich understanding of concepts, principles, models and theories...and learn science in a way that reflects how science actually works" (NRC, 1996: p214)

shifts the emphasis to how students learn, highlighting however the close connection between inquiry as scientific practice, and inquiry as student learning.

Inquiry-based science education has also been described as teaching and learning science as inquiry and by inquiry (Tamir, 1985; Chiappetta, 1997; Zion et al., 2004). Learning science as inquiry includes learning about the way in which the scientific endeavour progresses, and analyzing the inquiry process performed by others, sometimes using historical perspectives (Bybee, 2000; Schwab, 1962). Learning science by inquiry, on the other hand, involves the learner in raising research questions, generating a hypothesis, designing experiments to verify them, constructing and analyzing evidence-based arguments, recognizing alternative explanations, and communicating scientific arguments (Tamir, 1985). Teaching science by inquiry requires imparting not only scientific information but also the abilities to do inquiry and, more deeply, an understanding of what scientific inquiry is about.

Finally, there is overwhelming research evidence that inquiry leads to better acquisition of domain (conceptual) knowledge (de Jong, 2006a). A recent meta-analysis reviewing 138 studies indicated a clear advantage for inquiry-based instructional practices over other forms of instruction in conceptual understanding that students gain from their learning experience (Minner et al., 2010).

The Go-Lab project acknowledges the need for science teachers to bestow their students with the knowledge and ability to engage in inquiry but also with an understanding of inquiry and of how inquiry results in scientific knowledge.

2.2 Background: About Technology Enhanced Learning [TEL] environments for inquiry learning

Technology Enhanced Learning (TEL) approaches to science learning provide students with ample opportunities for inquiry. TEL environments that offer simulations, games, data sets, and/or remote and virtual laboratories are significant in this respect. In these environments technological affordances are directly used for pedagogical purposes in that inquiry calls for non-linear, manipulable, and runnable content which technology is able to offer. Evidence is accumulating that TEL inquiry environments provide students with genuinely effective learning opportunities and large scale studies show that, on different outcome measures, TEL-based inquiry outperforms more direct approaches to instruction (Alfieri et al., 2011; Deslauriers & Wieman, 2011; Eysink et al., 2009; Marusić & Slisko, 2012; Scalise et al., 2011; Smetana & Bell, 2012).

These promising results, however, only hold when the inquiry process is structured and scaffolded. Scaffolds thus play a pivotal role in inquiry learning. Scaffolds come in many kinds. Examples are tools to create hypothesis, data analysis tools, and tools to save and monitor experiments.

Currently a growing number of TEL inquiry environments have emerged that provide students with inquiry facilities together with integrated supportive structure and scaffolds. Examples of such learning environments are: Smithtown (Shute & Glaser, 1990); Belvedere (Suthers et al., 1995); BGuILE (Reiser et al., 2001); BioWorld (Lajoie et al., 2001); Inquiry Island (White et al., 2002); GenScope (Hickey et al., 2003; Hickey & Zuiker, 2003); SimQuest-based environments (de Jong et al., 1998); Co-Lab (van Joolingen et al., 2005); WISE (Linn et al., 2004); STOCHASMOS (Kyza et al., 2011); and SCY (de Jong et al., 2010). All these environments are based on simulations and/or remote labs.

Go-Lab has a repository of data sets, remote and virtual labs (hereforth called 'online labs'), and focuses on combining them and integrating them with supportive structure and scaffolds.

2.2.1 The distinctive virtues of remote and virtual labs

Remotely-operated educational labs ('*remote labs*') provide students with the opportunity to collect data from a real physical laboratory setup, including real equipment, from remote locations. As an alternative there are *virtual labs* that simulate the real equipment and experiment. Remote and virtual labs both have specific advantages for learning.

The first advantage of remote labs is that they do not mimic the real lab but students actually operate on real equipment. Remote labs thus give students a more realistic view on scientific practice and lab work, including practical aspects such as occupied equipment etc. Another advantage of remote labs is that measurement errors are present by nature, whereas in virtual environments measurement errors are often ignored. Competency in a domain includes knowledge that measurement errors (of different kinds) exist and how to deal with them (Toth et al., 2009). The reading of instruments in a virtual lab, on the other hand (especially with a possibility to zoom in) is by nature easier than reading real instruments.

Concerning the ease of experimentation the advantages go in the direction of virtual labs. In virtual laboratories students can experiment without any costs and can more easily and repeatedly experiment so that ideas can be quickly tested and evaluated. Another advantage for virtual laboratories is that reality can be adapted to serve the learning process. Reality can both be simplified by taking out details (and thus lowering fidelity) or be 'augmented' by adding specific features to reality (such as adding vectors to moving objects). Lowering fidelity means that the requirements on students are less severe which may add learning (Alessi, 1988). Augmenting reality means that concepts that are not visible for students in the physical laboratory now become visible (such as the flow of electric current, see e.g., Jaakkola et al., 2010).

Corter and colleagues (Corter, et al., 2007; 2011), who compared a real, remote and simulated lab on the same (mechanical engineering) topic found no differences in learning outcomes but found that student appreciated the remote and real labs more because of their realism. Kong, Yeung, and Wu (2009) also report that both teachers and students show high involvement in remote laboratories.

In conclusion, remote and virtual labs both have their specific virtues to bring to the learning situation; each of them also focusing on partly overlapping but also different learning goals (Ma & Nickerson, 2006). **Go-Lab promotes the use of both these kinds of labs for all the reasons specified above.**

2.2.2 The role of scaffolds in inquiry learning with online labs

Scaffolding refers to support (dedicated software tools) that helps students with tasks or parts of a task that they cannot complete on their own. Scaffolds aim at the different learning processes that constitute inquiry learning. For example, they can help students to create hypotheses (van Joolingen & de Jong, 1991), design experiments (Lin & Lehman, 1999), make predictions (Lewis et al., 1993), formulate interpretations of the data (Edelson et al., 1999), reflect upon the learning process (Davis, 2000), plan and structure their work (van Joolingen, et al., 2005), and monitor what has been done (Hulshof et al., 2005). We can also scaffold the complete process by having student work with an inquiry cycle (Manlove et al., 2007). Different types of structuring and scaffolds and their effects on knowledge acquisition have been overviewed in several studies (Bell et al., 2010; Chang, et al., 2008; de Jong, 2006b, 2010a, 2010b; de Jong & van Joolingen, 1998; Fund, 2007; Linn, et al., 2004; Quintana et al., 2004;

Sandoval & Bell, 2004; Zhang et al., 2004). In any case meta-analyses (Alfieri et al., 2011) show that inquiry learning is only productive when the inquiry process is structured and scaffolded.

To structure and scaffold the inquiry process, Go-Lab has designed an inquiry cycle and a set of scaffolds (tools) that are basically domain and age independent but that can be adapted to fit a certain age of students or a certain domain of science. The scaffolds in Go-Lab function as applications complementing the Go-Lab online lab interface applications.

2.3 The Go-Lab Inquiry Cycle

As mentioned above, Go-Lab has developed an inquiry cycle that provides students with a single recognizable inquiry structure that still can be personalized to domain and age, and potentially other student related characteristics.

The Go-Lab Inquiry Cycle is graphically presented in Figure 1.

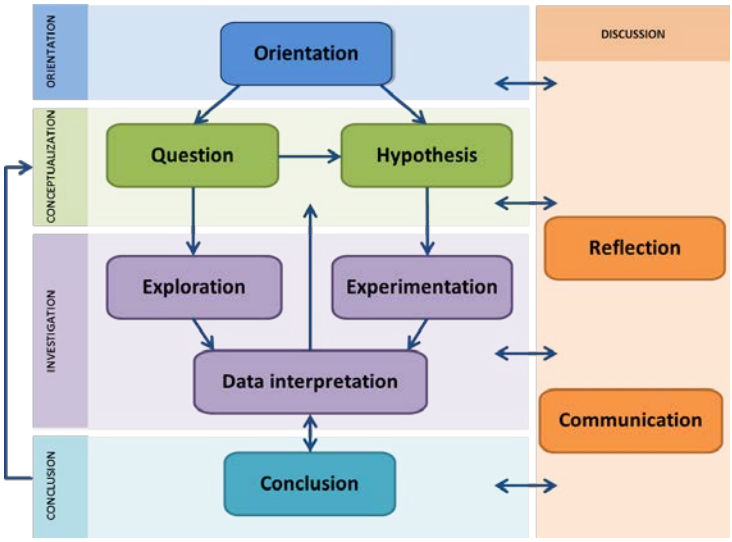


Figure 1: The Go-Lab inquiry cycle template

In this, the basic inquiry activities are summarized in five phases: *Orientation, Conceptualization, Investigation, Conclusion*, and *Discussion.*

- *Orientation* focuses on stimulating interest towards the domain and curiosity to carry out an inquiry.
- *Conceptualization* consists of two alternative sub-phases, *Question* and *Hypothesis.* Both sub-phases concern the relations between independent and dependent variables about the phenomenon under study. More specific, “hypothesizing is a formulation of a statement or a set of statements (de Jong, 2006), while questioning is a formulation of investigable questions” (Pedaste et al., 2015).
- *Investigation* has three sub-phases; *Exploration*, *Experimentation* and *Data Interpretation*. *Exploration* is a systematic way of carrying out an investigation with the intention to find indications for a relation between the variables involved. *Experimentation* concentrates on selecting variables, the values and the order of the manipulation. *Data Interpretation* focuses on making meaning out of the collected data.
- *Conclusion* is a phase of reaching basic conclusions of the experiments/ investigations.
- *Discussion* concerns the sharing of one’s inquiry by *Communication* and *Reflection*. *Communication* is presenting/reporting and sharing the outcomes of the inquiry with

others, while *Reflection* is the process of describing, critiquing, evaluating and discussing the whole inquiry process or a specific phase.

Some general guidelines on how these five inquiry phases can be used in science teaching and learning are included in section 3.2.3. In addition, based on this inquiry cycle, seven Go-Lab classroom inquiry scenarios have been elaborated as pedagogical suggestions of use in specific classroom settings. These are presented in the corresponding 'Go-Lab Classroom Scenarios Handbook' (Deliverable D1.4).

The Go-Lab inquiry cycle, the cognitive scaffolds and online labs come together in the Go-Lab inquiry learning spaces (ILSs) (see section 3.2), via which students experience the Go-Lab inquiry activities.

2.4 Go-Lab and the 'Big Ideas' of Science

It is often the case that although students learn about fundamental principles, they fail to understand the connection between them, as well as the connection to their life and world. To help teachers facilitate the development of this understanding in their students Go-Lab has organised its online labs and ILSs according to the 'Big Ideas' of Science, in addition to a number of other more conventional metadata (e.g. school phase, science topic, age of students, etc.). These 'Big Ideas' represent overarching principles in the science curriculum and can also be looked at as 'umbrellas' where the content material from various science subjects can be brought under the same 'umbrella' in order to develop a common theme running through the science curricula over time. According to Harlen's report (2010) the goals of science education should not be conceived *"in terms of the knowledge of a body of facts and theories but a progression towards key ideas which together enable understanding of events and phenomena of relevance to students' lives during and beyond their school years."* In her report 14 such ideas are identified and include ideas *of* science and ideas *about* science and its role in society.

Based on these, Go-Lab has developed its set of 'Big Ideas' of Science and expressed them in ways appropriate to learners at various stages in cognitive development. This set can be considered as a backbone structure that students can build upon so as to connect the different science subjects taught in school and see the relevance of different science principles and phenomena to their lives. Each online lab, as well as each ILS in Go-Lab is tagged with the Big Idea(s) that it aims to reflect. By working with multiple online labs and/or ILSs, which have common Big Ideas behind them (but are not necessarily about the same subject), students will be able to understand better and deeper certain key science concepts and processes, and their application to everyday phenomena.

Table 1, presents the Go-Lab 'Big Ideas' of Science set. It is comprised of eight fundamental key science ideas. These are expressed as brief sentences, which contain in a nutshell the essence of the 'Big Ideas', accompanied by some complementary explanatory information.

Table 1. *The Go-Lab 'Big Ideas' of Science*

1. Energy cannot be created or destroyed.
It can only transform from one form to another. The transformation of energy can lead to a change of state or motion. Energy can also turn into mass and vice versa.
2. There are four fundamental interactions/ forces in nature.
Gravitation, electromagnetism, strong-nuclear and weak nuclear. All phenomena are due to the presence of one or more of these interactions. Forces act on objects and can act at a

distance through a respective physical field causing a change in motion or in the state of matter.

3. **Earth is a very small part of the universe.**

The Universe is comprised of billions of galaxies each of which contains billions of stars (suns) and other celestial objects. Earth is small part of a solar system with our Sun in its centre that in turn is a very small part of the Universe.

4. **All matter in the Universe is made of very small particles.**

They are in constant motion and the bonds between them are formed by interactions between them. Elementary particles as we know them so far form atoms and atoms form molecules. There is a finite number of types of atoms in the universe which are the elements of the periodic table.

5. **In very small scales our world is subjected to the laws of quantum mechanics.**

All matter and radiation exhibit both wave and particle properties. We cannot simultaneously know the position and the momentum of a particle.

6. **Evolution is the basis for both the unity of life and the biodiversity of organisms (living and extinct).**

Organisms pass on genetic information from one generation to another.

7. **Organisms are organized on a cellular basis.**

They require a supply of energy and materials. All life forms on our planet are based on this common key component.

8. **Earth is a system of systems which influences and is influenced by life on the planet.**

The processes occurring within this system influence the evolution of our planet, shapes its climate and surface. The solar system also influences Earth and life on the planet.

As previously said, teachers can use this set in class to connect concepts and phenomena coming from different parts of the science curriculum. For example, the second ‘Big Idea’ can be used to help students understand the common background between the movement of celestial objects and how magnets can attract iron objects. Below teachers may find an indicative correlation between the Go-Lab ‘Big Ideas’ of Science and the basic themes that are found in most school science curricula.

This proposed categorization suggests possible connections between different online labs and inquiry learning activities and thus enable teachers to make selections not only in order to carry out isolated activities but also to pre-define a group of activities that if used in sequence may provide students with a coherent set, which will allow them to acquire a better perspective on the connection between different natural phenomena.

1. Energy cannot be created or destroyed. It can only transform from one form to another. The transformation of energy can lead to a change of state or motion. Energy can also turn into mass and vice versa.
Astronomy
Energy
Chemical reactions
Forces and motion
High energy physics
Light
Life processes
Sound

The activities that focus on the investigation of different motions and of phenomena that involve the transfer of energy from one source to another are included in this set. Such activities can cover subject areas like mechanics (free fall motion, springs, etc.), thermodynamics (internal energy, entropy and pressure), quantum mechanics and nuclear physics (binding energy, quantum models, ionization), as well as wave motions and chemical reactions.

2. There are four fundamental interactions/ forces in nature. Gravitation, electromagnetism, strong-nuclear and weak nuclear. All phenomena are due to the presence of one or more of these interactions. Forces act on objects and can act at a distance through a respective physical field causing a change in motion or in the state of matter.
Astronomy
Electricity and magnetism
Energy
Fields
Forces and motion
High Energy Physics
Light
Radioactivity

These activities can investigate interactions in all scales of the Universe, from particle interactions and radioactivity to the orbits of the planets and the formation of galaxies. Activities that investigate phenomena which are due to the electromagnetic force, like the movements of charged particles or light, are also included in this category.

3. Earth is a very small part of the universe. The Universe is comprised of billions of galaxies each of which contains billions of stars (suns) and other celestial objects. Earth is small part of a solar system with our Sun in its centre that in turn is a very small part of the Universe.
Astronomy
High energy physics
Light
Life processes
Forces and motion

Activities that cover the investigation of large scale phenomena occurring in our Universe belong in this set. Such activities can involve the observation of the motion of celestial objects, the investigation of their creation, etc..

4. All matter in the Universe is made of very small particles.

They are in constant motion and the bonds between them are formed by interactions between them. Elementary particles as we know them so far form atoms and atoms form molecules. There is a finite number of types of atoms in the universe which are the elements of the periodic table.
Analytical chemistry
Chemical reactions
Energy
Forces and motion
Inorganic chemistry
Obtaining and using materials
Organic chemistry
Physical chemistry
High energy physics
Radioactivity
Solids, liquids and gases

Any kind of activities that studies the structure of matter fits in this category. For example, activities of high energy physics that study elementary particles or any kind of chemistry activities that study the structure of atoms, molecules and ions, as well as the interactions between them.

5. In very small scales our world is subjected to the laws of quantum mechanics. **All matter and radiation exhibit both wave and particle properties. We cannot simultaneously know the position and the momentum of a particle.**
Energy
Forces and Motion
High energy physics
Light
Radioactivity
Sound
Waves

This section is closely connected to the second set and covers all activities that are connected with waves and wave behaviour. All activities connected to optics, the properties of light and sound, as well as activities that study oscillations are included in this set.

6. Evolution is the basis for both the unity of life and the biodiversity of organisms (living and extinct). **Organisms pass on genetic information from one generation to another.**
Anatomy
Botany
Ecology
Humans and animals
Life processes
Variation, inheritance and evolution

Biology activities connected to the study of life processes, the evolution of living organisms and the study of DNA are included in this category.

7. Organisms are organized on a cellular basis. They require a supply of energy and materials. All life forms on our planet are based on this common key component.
Anatomy
Botany
Humans and animals
Life processes
Organic chemistry
Physical chemistry

This section involves activities that cover the anatomy of living organisms and the different functions of cells. Chemistry activities connected to the chemical reactions that take please within living organisms are also included.

8. Earth is a system of systems which influences and is influenced by life on the planet. The processes occurring within this system influence the evolution of our planet, shapes its climate and surface. The solar system also influences Earth and life on the planet.
Botany
Climate
Earth science
Ecology
Environment
Environmental protection
Geography
Natural resources
Obtaining and using materials
Radioactivity
Solids, liquids and gases
Useful materials and products

This set covers a wide a range of activities. The activities included are connected with the investigation of processes occurring on Earth. Activities that simulate the effect of human activities on our environment, environmental pollution and the investigation of our climate (like meteorological satellites data sets) are included in this set. Other activities that investigate the surface and the underground of the planet as well as the materials obtained are also included in this set.

3 The Go-Lab Portal

The main objective of the Go-Lab Portal (http://www.golabz.eu) is to provide a very simple and attractive platform for teachers and learners to support their inquiry learning activities for science education at school. In particular, when targeting the teachers the Portal aims to provide:

- a repository of online labs (Figure 2 – [1]) and inquiry learning spaces (ILSs) (Figure 2 – [2]) (also called 'GoLabz') to use in their science classroom;
- access to an authoring environment and tools to design their own ILSs (Figure 2 – [3]) (also called 'Graasp'), and to applications to support and scaffold the inquiry learning process of their students (Figure 2 – [4]);
- support services and access to peers, communities and scientists (also called 'Tutoring platform') to facilitate the use of the Go-Lab learning environment and uptake of inquiry learning activities in the classroom (Figure 2 – [5]).

On the other hand, when targeting the learners the Go-Lab Portal aims to provide a unique user experience in terms of interaction, as well as user interfaces and services as transparent as possible for carrying out remote and/or virtual experimentation.

The coming sections and chapters are step-by-step guides to each of these provisions in turn.

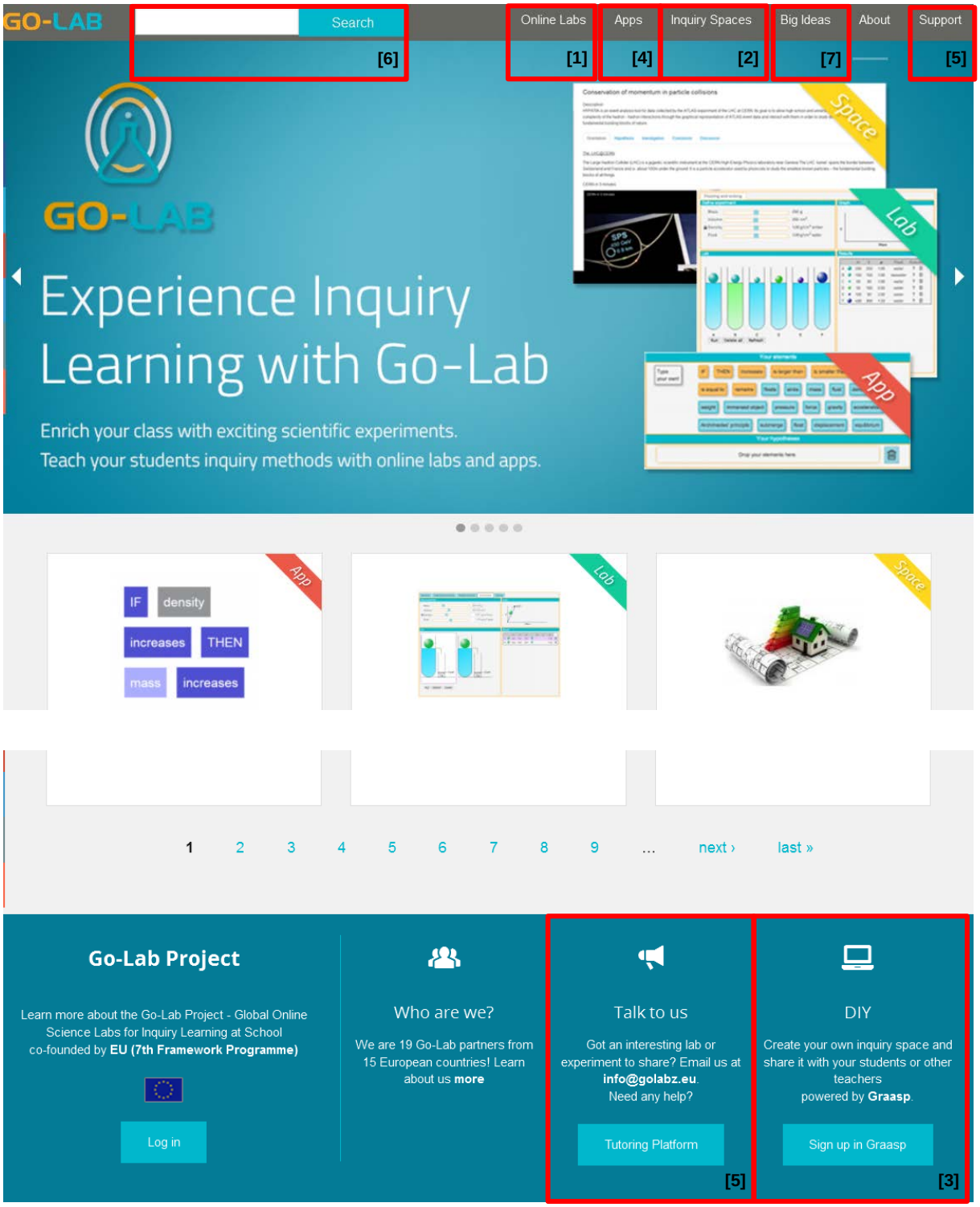


Figure 2: The Go-Lab Portal

3.1 Go-Lab Online labs

A very significant intended use of the Go-Lab environment is to access a large number of online labs through its related repository. These can be either accessed and used independently of any other Go-Lab resources, or can be integrated in and used as part of the Inquiry Learning Spaces (ILSs) created. The following section refers to how one can look for a Go-Lab online lab, whereas section 4.4.3.5 shows how users can incorporate these labs in their ILSs.

3.1.1 Searching for an online lab

To look for an online lab in the Go-Lab portal, there are three ways you can go about it:

1) Search by keyword(s), using the general Search facility (Figure 2 – [6]) of the Portal. The facility will look to find any resources, including online labs, which have the keyword(s) appearing in their title, description or tags.
2) Click on the "Online Labs" link (Figure 2 – [1]) at the top of the Go-Lab homepage and then in the dedicated page that opens (Figure 3), limit the labs that appear by:
    a) **sorting** them (Figure 3 – [1]):
        - Alphabetically; or by
        - their Popularity amongst users;
        - the Date they were Published;
        - the Date they were last Updated.

    and/or

    b) filtering them (Figure 3 – [2]) using one or more of the following criteria:
        - Subject domain(s) they address;
        - Age range of learners you intend to use them with;
        - Language it uses;
        - Level of difficulty (for the learners);
        - Level of interaction (for the learners);
        - Type of lab;
3) Click on the "Big Ideas" link (Figure 2 – [7]) at the top of the Go-Lab homepage; then in the dedicated page that opens (Figure 4) click on the 'Big Idea' of Science you wish to address in your science teaching. In a new page you will find all online labs related to this idea (see for example Figure 5 – [1]).

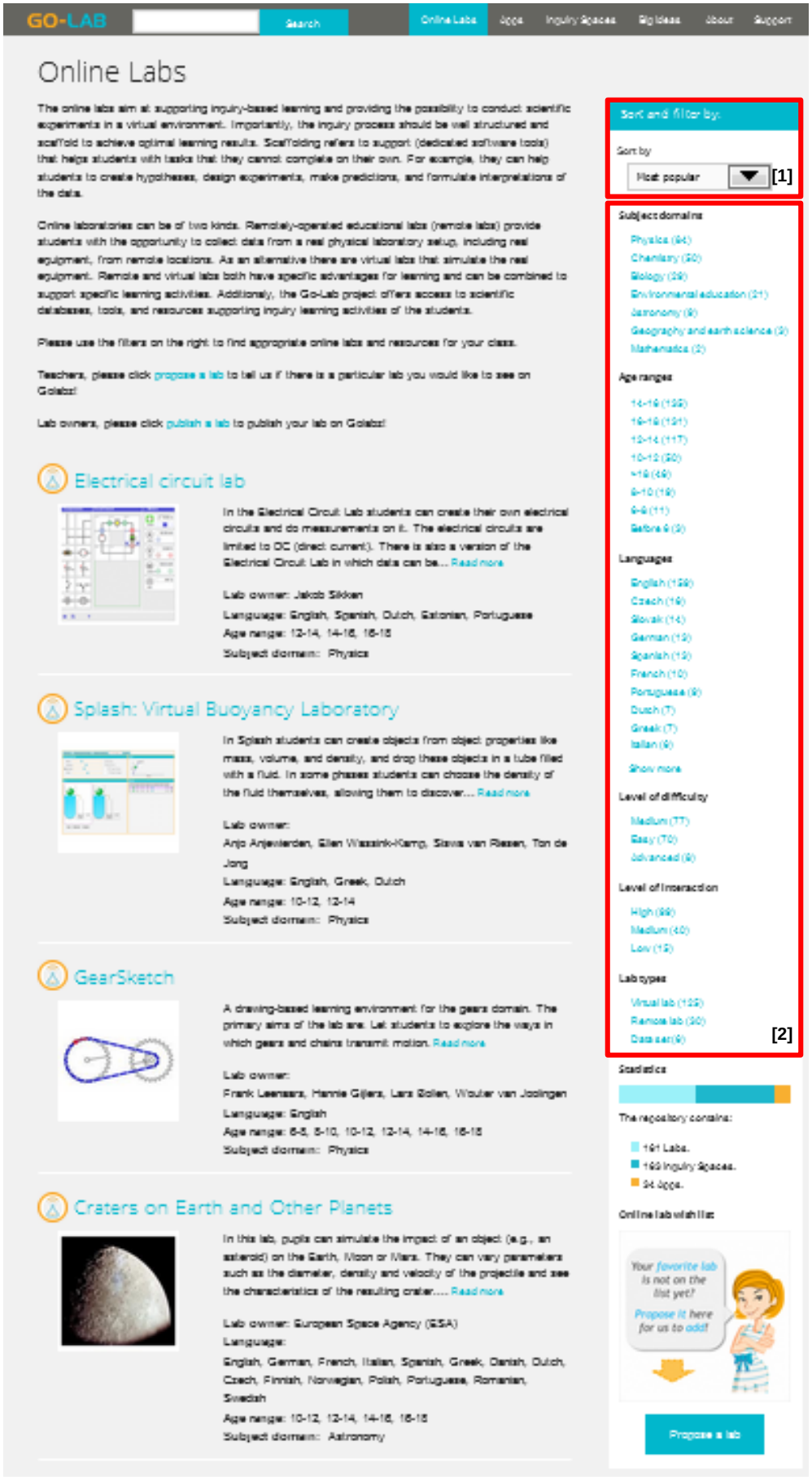


Figure 3: The Go-Lab Online Labs

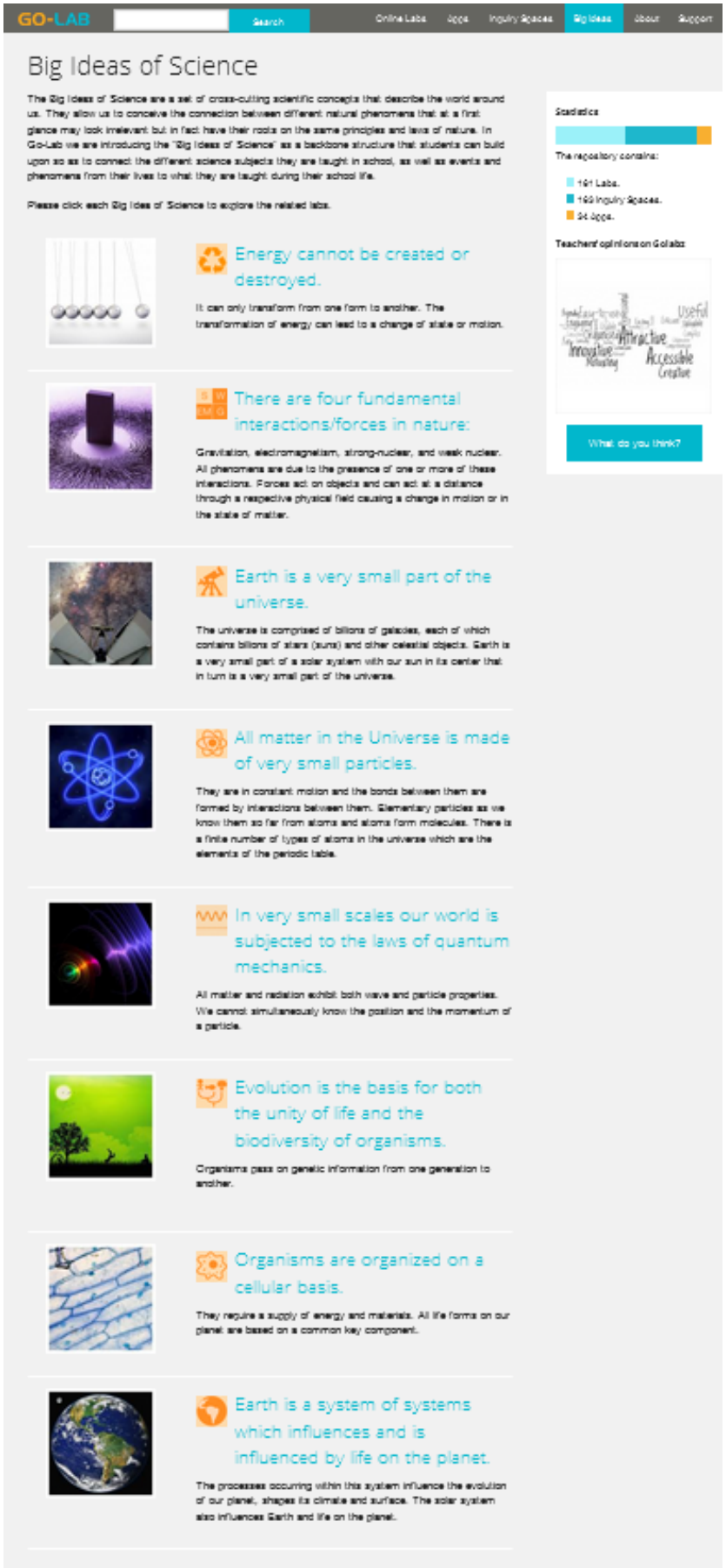


Figure 4: The Go-Lab 'Big Ideas' of Science



Figure 5: Online labs and ILSs related to the 'Big Idea' of energy conservation

3.1.2 Using an online lab

Once you choose the Go-Lab online lab you might like to use, by clicking on it, you can see all the information relating to it (see for example Figure 6), including its technical requirements (Figure 6 – [1]), and find links to additional supportive materials, if appropriate (Figure 6 – [2]). The "Preview" link (Figure 6 – [3]) takes you to the lab itself.

On the same page you can find inquiry learning spaces which make use of the specific lab (Figure 6 – [4]), as well as a list of similar labs (Figure 6 – [5]). Finally, at the bottom of the page you can read other users' comments and/or post your comment about it (Figure 6 – [6]).

There are two ways you can use a Go-Lab online lab in your science classroom:

- As a standalone application to suit your purposes;
- In the frame of the Go-Lab environment, and in particular of an Inquiry Learning Space, and following one of the seven inquiry scenarios provided, to promote technology-enhanced inquiry learning in your students.

The latter use is the main focus of these guidelines and in particular of section 4.4.3.5.



Figure 6: Information about an online lab

3.2 Go-Lab Inquiry Spaces

Inquiry Learning Spaces (ILSs or “Inquiry Spaces”) in Go-Lab are inquiry-based activities that are structured using the Go-Lab Inquiry Cycle and can contain labs, learning resources and applications to enable and support inquiry learning. Learning resources are typically texts, videos and other materials to assist and assess students. Applications (or “Apps”), also known as tools or widgets, are small web based software applications supporting specific inquiry learning or teaching goals and tasks (see section 3.3). Teachers usually set up an Inquiry Space for their students. An Inquiry Space can be shared with other teachers who can repurpose and adapt it to fit their purpose.

The following is concerned with how teachers can search for existing Go-Lab Inquiry Spaces and how they can use the Go-Lab Inquiry Cycle within these spaces, whereas Chapter 4 gives technical guidelines about how teachers can make use of, modify or create them.

3.2.1 Searching for an ILS

To look for an ILS in the Go-Lab portal, there are three ways you can go about it:

1) Search by keyword(s), using the general Search facility (Figure 2 – [6]) of the Portal. The facility will look to find any resources, including ILSs, which have the keyword(s) appearing in their title, content or tags.
2) Click on the “Inquiry Spaces” link (Figure 2 – [2]) at the top of the Go-Lab homepage and then in the dedicated page that opens (Figure 7), limit the inquiry spaces that appear by:
    a) **sorting** them (Figure 7 – [1]):
        - Alphabetically; or by
        - their Popularity amongst users;
        - the Date they were Published;
        - the Date they were last Updated.

    and/or

    b) filtering them (Figure 7 – [2]) using one or more of the following criteria:
        - Subject domain(s) they address;
        - Age range of learners you intend to use them with;
        - Language it uses;
        - Level of difficulty (for the learners)
3) Click on the “Big Ideas” link (Figure 2 – [7]) at the top of the Go-Lab homepage; then in the dedicated page that opens (Figure 4) click on the ‘Big Idea’ of Science you wish to address in your science teaching. In a new page you will find (following the “Related labs”) all ILSs related to this idea (see for example Figure 5 – [2]).
4) Finally, as mentioned also above, on the webpage of each selected lab you can find all the ILSs that make use of it (Figure 6 - [4]).

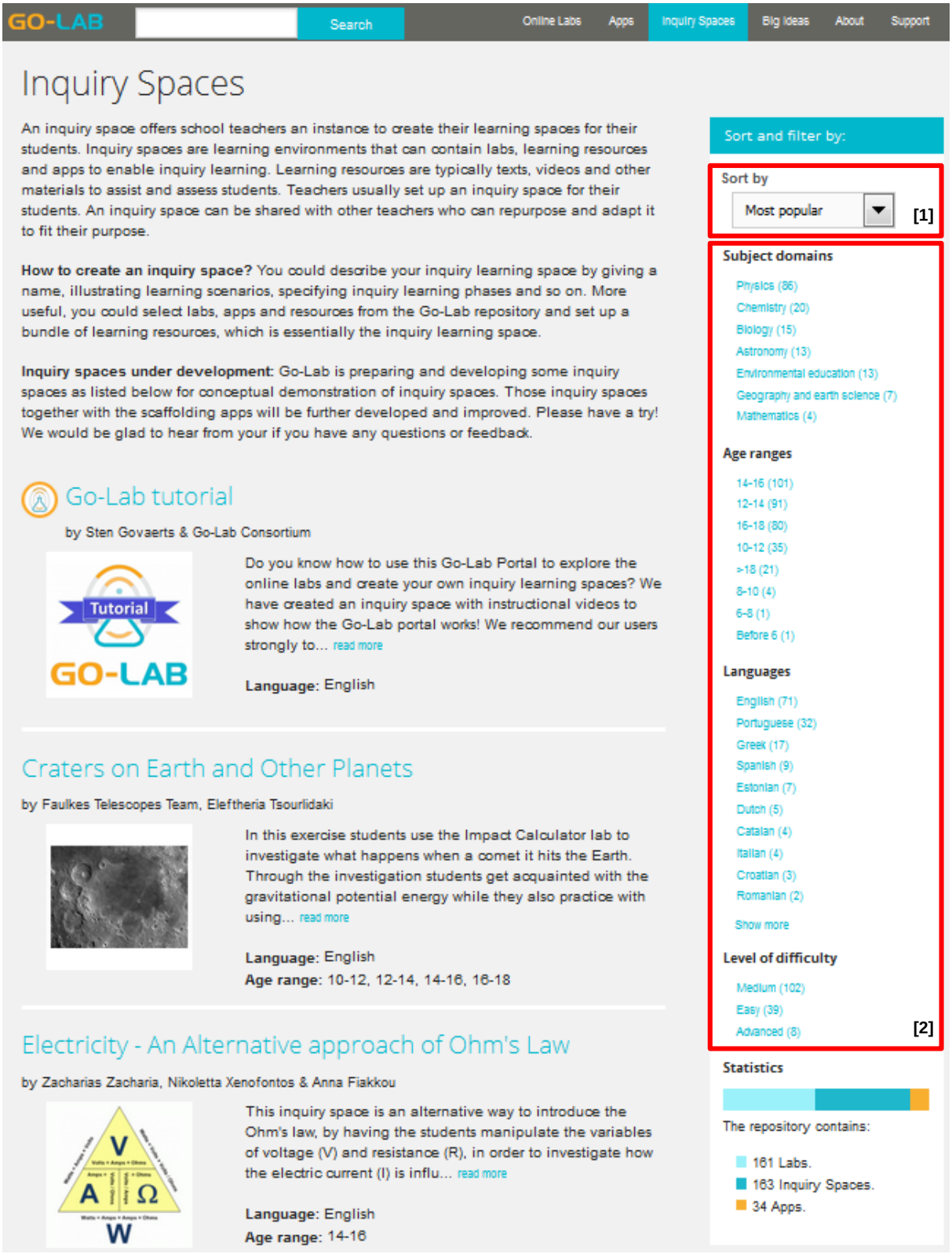


Figure 7: The Go-Lab Inquiry Spaces

3.2.2 Using an ILS

Once you choose the ILS you might like to use, by clicking on it, you can see all the information relating to it (see for example Figure 8), including the Go-Lab inquiry scenario it uses (Figure 8 – [1]); its educational objective(s) (Figure 8 – [2]); and its organisational (Figure 8 – [3]), and students' prior knowledge requirements (Figure 8 – [4]). The "Students' link" (Figure 8 – [5])

takes you to a preview of the ILS as a student would see it, in 'Graasp', which is a different learning environment (also called the 'Go-Lab authoring environment' or 'ILS Platform'). Please note that you need to give a 'Nickname' in order to enter the Go-Lab authoring environment and preview the ILS.

At the bottom of the page you can read other users' comments and/or post your comment about it (Figure 8 – [6]).

There are three ways you can make use of a Go-Lab ILS in your science classroom:

- Choose an existing ILS and use it as it is;
- Choose an existing ILS, adapt it to suit the learning needs of your students and organisational structure of your classroom;
- Create your own ILS from scratch.

All three ways require a (varied) knowledge of the Go-Lab authoring environment 'Graasp' and are discussed in Chapter 4.

They also require an understanding of the basic Go-Lab Inquiry Cycle and its five phases. The background information about the Go-Lab Inquiry Cycle is given in section 2.3. The following section (3.2.3) give some broad guidelines about how you can use it the classroom. Finally, as mentioned before, based on the Go-Lab inquiry cycle, seven Go-Lab classroom inquiry scenarios have been elaborated as pedagogical suggestions of use in specific classroom settings. These are presented in the corresponding 'Go-Lab Classroom Scenarios Handbook' (Deliverable D1.4).

3.2.3 Using the Go-Lab Inquiry Cycle in an ILS

In the inquiry cycle presented in Figure 1, you, as contributor of an ILS, can choose to follow different inquiry pathways, as defined by the arrows in the image, depending on the level of complexity of the activity you plan to create.

The three main possible inquiry pathways are indicated with arrows as seen in the image (Figure 1):

a) Orientation—Question—Exploration—Data Interpretation—Conclusion;

b) Orientation—Hypothesis—Experimentation—Data Interpretation—Conclusion; and

c) Orientation—Question—Hypothesis—Experimentation—Data Interpretation—Conclusion.

The "Discussion" phase can be seen as a process that is "optional" in the inquiry cycle, while in the individual learning process inquiry outcomes can be reached without any discussion. However, the quality of the whole inquiry and related learning gains depend on the discussions in each inquiry phase and/or after completing all other phases. Below one may see a brief explanation and some guidelines for each phase of the inquiry cycle.

Orientation

Orientation is focused on stimulating students' interest and curiosity towards the problem at hand. During this phase the learning topic is introduced and the main variables are identified. You may introduce the topic by adding materials like for example videos, photos or images that would initiate a discussion and that the students can use in order to familiarize themselves with the problem at hand.

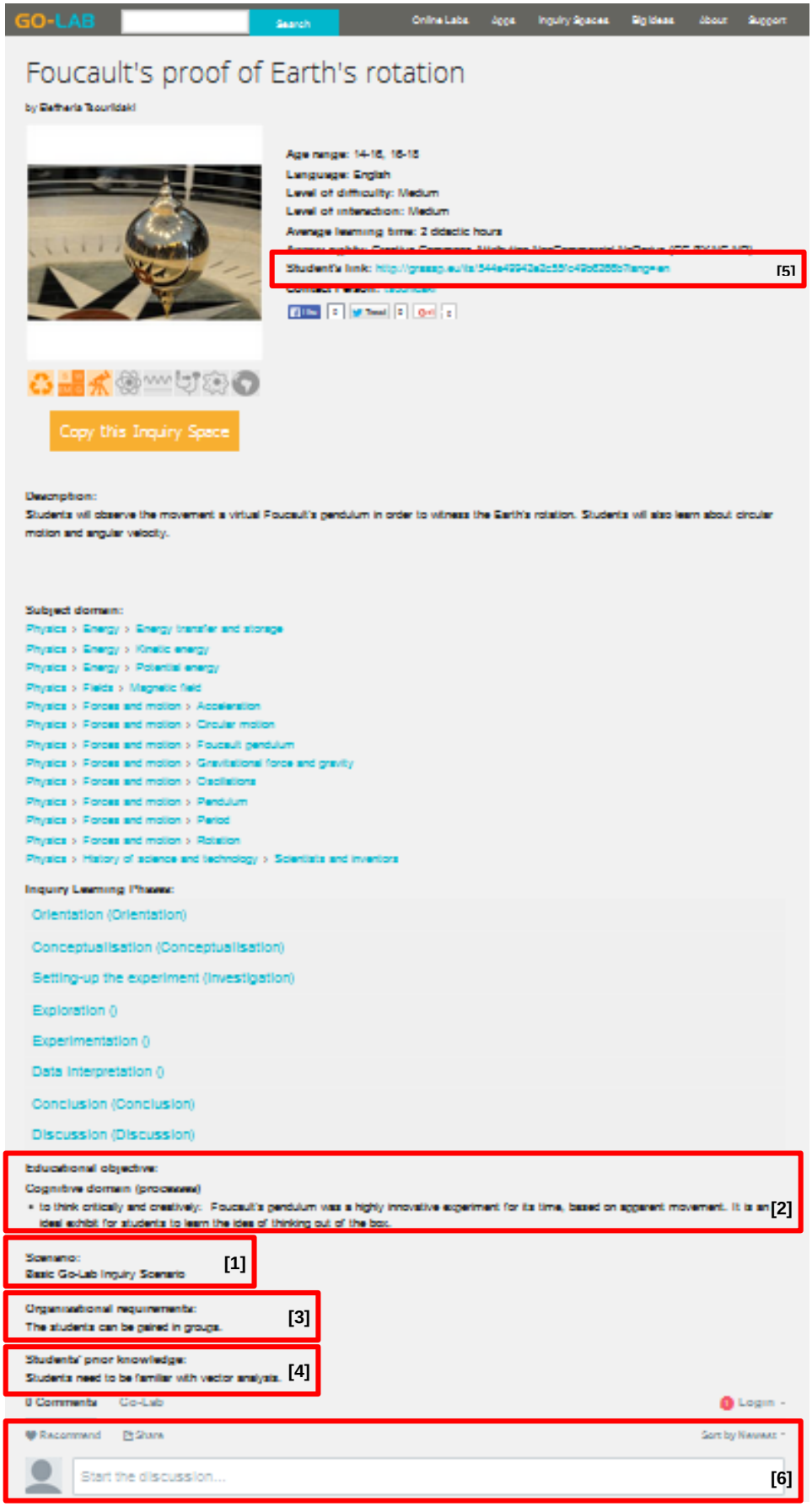


Figure 8: Information about an ILS

Conceptualization

Conceptualization is a process of understanding a concept or concepts connected to the problem that has been presented. It is divided into two (alternative) sub-phases, Question and Hypothesis whose outcomes have similar components.

You may encourage their students to identify all the concepts that are related to the problem under discussion and make the correct connections between them. They can do that by creating a concept map.

Tip: You should not point out any mistakes students might make. Students are supposed to discover these mistakes themselves and correct them. Alternatively, you may note them down and bring them back to students' attention at a later stage.

Sub-phase 1: Question

Question is a process of generating research questions based on the stated problem.

After students have identified all the related concepts, you may guide them to formulate their questions on the subject.

Sub-phase 2: Hypothesis

Hypothesis is a process of generating hypotheses on the stated problem based on theoretical justification.

After students have identified all the related concepts, you may guide them to make specific hypotheses, which they will later set out to investigate.

Investigation

Investigation is where curiosity is turned into action in order to respond to a stated research question or hypothesis. Students design plans for experiments, investigate by changing variable values, explore and interpret outcomes. Investigation has three-sub phases; Exploration, Experimentation and Data Interpretation. In this phase you should introduce the online labs students are going to use.

Sub-phase 1: Exploration

Exploration is a systematic way of carrying out data manipulation with the intention to find indications for a relation between the variables involved. In Exploration there is no specific expectation of the outcome of the data manipulation and it naturally follows the Question phase.

You may encourage their students to propose ways to explore the questions they have set and try to retrieve information.

Sub-phase 2: Experimentation

Experimentation concentrates on developing and applying a plan for a data manipulation with a specific expectation of the outcome in mind and naturally follows the Hypothesis sub-phase.

You may encourage their students to make an investigation plan and put it in action in order to investigate the hypotheses they have set. You may ask them what kind of tools they will need to deploy and what parameters they will have to investigate.

Tip 1: You should make sure students understand the connection between the investigation and the hypotheses they have made. In other words, you should make sure they understand why they are doing every single step.

Tip 2: Students also have the tendency to change variables in an uncoordinated way. You should guide them so as to make their investigation as systematic as possible by changing

only one variable at a time and by keeping notes not only for their data but also about the process itself.

Sub-phase 3: Data interpretation

Data interpretation is needed to make meaning out of collected data and synthesizing new knowledge.

You may guide your students to propose ways on how they may make use of their data. You could propose to them different options like making graphs, deploying mathematical equations and formulas. You may also guide your students to check and make use of the relevant theories.

Conclusion

Conclusion is a phase for drawing the basic conclusions based on the data that have been collected and processed during the investigation that was carried out. In this phase learners address their original research questions or hypotheses and consider whether these are answered or supported by the outcomes of their investigation. It leads to new theoretical insights – a more specific idea is created on the relation between variables (following Question) or whether the hypothesis is supported by the results of the study (following Hypothesis).

You may guide your students to draw their conclusions and ask them to compare these to their original hypothesis. If students have made any mistakes in the previous stages, you should bring these to their attention so as to correct them. Depending on the activity you may also need to ask students to compare their findings with the respective bibliography or theoretical values.

Discussion

Discussion is about sharing one's inquiry process and results. It involves the process of describing, critiquing, evaluating and discussing the whole inquiry process or a specific phase.

In each step of the inquiry cycle, you may generate a discussion by asking questions so as to stimulate your students and provoke their curiosity.

Sub-phase 1: Communication

Communication can be seen as the process where students present and communicate their inquiry findings and conclusions, while listening to others and articulating their own understandings.

You may encourage their students to put together a report which will describe every step of their experimentation. The report does not necessarily have to be an essay-type report. Students should be encouraged to come-up with creative ways to communicate their work. For example they can do a small video out of it, a prezi, a PowerPoint presentation or a poster like those presented by scientists during conferences.

Sub-phase 2: Reflection

Reflection is defined as the process of reflecting on the success of inquiry while proposing new problems for a new inquiry and suggesting how the inquiry process could be improved. Reflection is also defined as receiving feedback from students themselves, teachers or peers so as to improve this (sub-)phase or the whole inquiry process in a next trial.

You may generate a discussion among students to talk about their results. You may try to identify students' alternative explanations and point out stronger and weaker points in their work. Students should be encouraged to propose corrective moves and refinements in the original experimentation process.

3.3 Go-Lab Apps

As mentioned above Go-Lab Apps, also known as applications, tools or widgets, are small web based software applications supporting specific inquiry learning or teaching goals and tasks. Apps can be added to an ILS together with online labs. Apps are used within inquiry learning spaces according to their functionalities and purposes, and used to support particular experimenting and learning activities in online labs.

The following is concerned with how teachers can search for existing Go-Lab Apps, whereas Chapter 4 gives technical guidelines about how teachers can insert them and make use of them as part of an ILS.

3.3.1 Searching for an App

To look for an App in the Go-Lab portal there are two ways you can go about it:

1) Search by keyword(s), using the general Search facility (Figure 2 – [6]) of the Portal. The facility will look to find any resources, including Apps, which have the keyword(s) appearing in their title, description or tags.
2) Click on the "Apps" link (Figure 2 – [4]) at the top of the Go-Lab homepage and then in the dedicated page that opens (Figure 9), limit the inquiry spaces that appear by:
    a) **sorting** them (Figure 9 – [1]):
        - Alphabetically; or by
        - their Popularity amongst users;
        - the Date they were Published;
        - the Date they were last Updated.

    and/or

    b) **filtering** them (Figure 9 – [2]) by the category in which they are classified. The categories of Apps in Go-Lab are:
        - Go-Lab inquiry apps
        - General apps
        - Collaboration apps
        - Math related support apps
        - Learning analytics apps
        - Domain specific apps

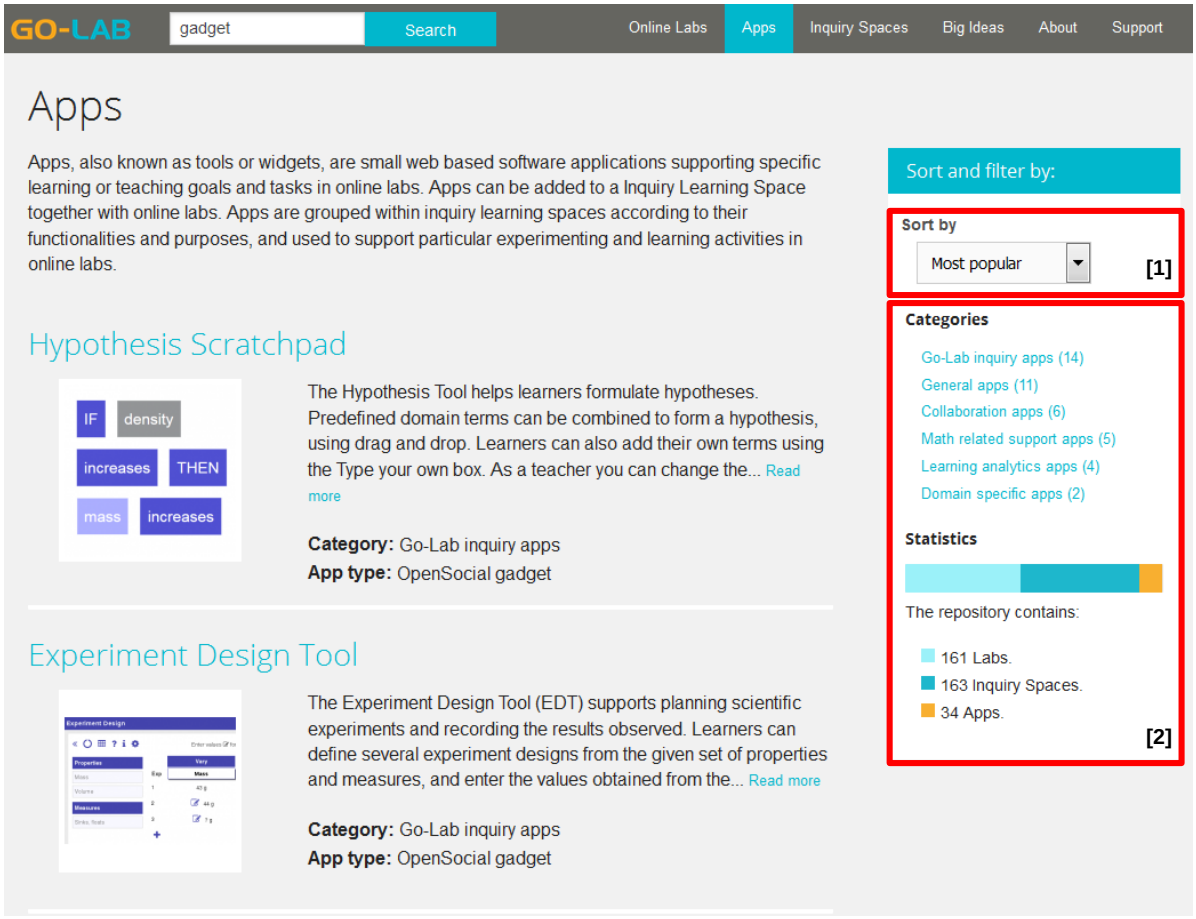


Figure 9: The Go-Lab Apps

4 The Go-Lab Authoring Environment (or ILS Platform) – Graasp

This chapter provides a step-by-step guide that helps teachers to use the Go-Lab authoring environment (or ILS Platform) 'Graasp' in order to:

- Make use of an existing ILS as it is;
- Modify and adapt an existing ILS to suit the learning needs of their students and organisational structure of their classroom;
- Create their own ILS.

4.1 Getting started with Graasp

In order to use Graasp you will first need to create an account. Visit the following address: http://graasp.eu/ and create an account. In order to finalize your account you will need to check your e-mail for a verification mail. Please make sure to also check the "Spam folder" in case the verification mail has been sent there. Once you create your account, you will be directed to your Graasp profile page (Figure 10).

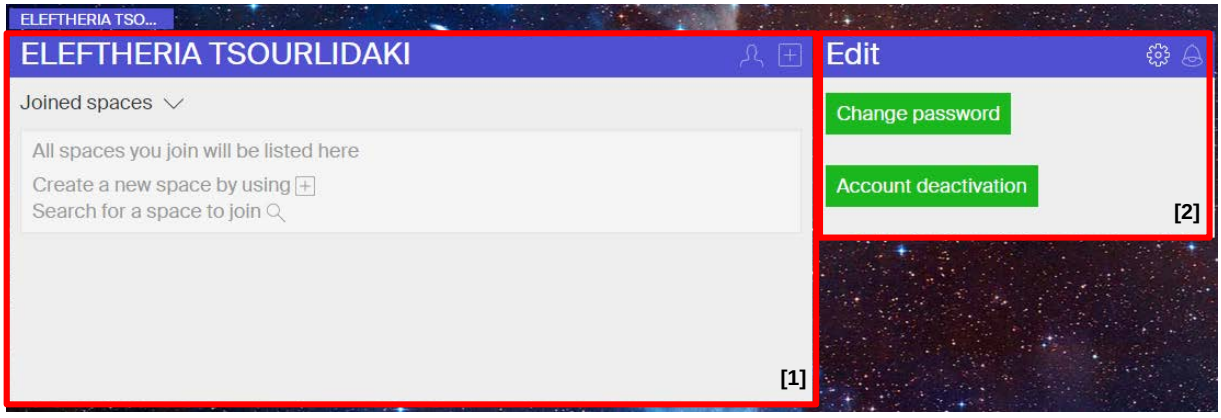


Figure 10: A new Graasp profile

In the main box (Figure 10 – [1]) of your profile you will find all the spaces you will create from now on as well as those that you will join. On the top right of the main box there are two options. The profile option (avatar icon) allows you to edit your profile by adding a picture and a brief description of yourself. The "+" icon allows you to create a new space or a new Inquiry Space.

In the side box (Figure 10 – [2]) another two options are available: Edit (gear icon on the right) which allows you to change your password and deactivate your account and Notifications (bell icon on the right) which allows you to view the recent activities of other users on spaces that you have created or joined.

After joining or/and creating a few Inquiry Spaces, they will all be displayed in your profile page as presented in Figure 11.

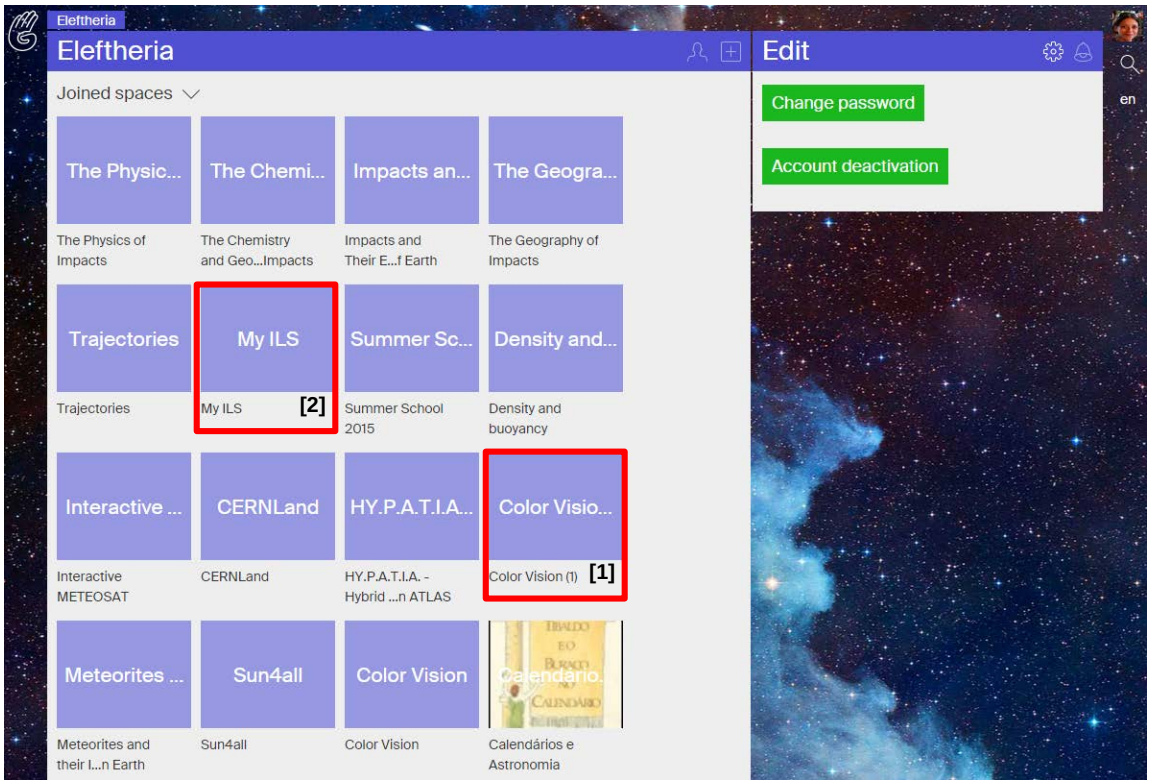


Figure 11: A Graasp profile

4.2 Make use of an existing ILS

As mentioned in section 3.2.2, if you wish to preview an ILS that is published in Go-Lab all you need to do is click on the “Students’ link” (Figure 8 – [5], Figure 12 – [1]) in the ILS page in the Go-Lab portal.

If however you wish to make use of the ILS in your classroom you must get access not only to the standalone view of the ILS but also to the respective inquiry space in Graasp. To do that, click on the “Copy this Inquiry Space” button (Figure 12 – [2]). A clone of the original inquiry space will then be created in your own account (e.g. Figure 11 – [1]).

In order to use it with your students, please read first the guidelines in section 4.4.1 below. More particularly, you need to use the “Sharing” function (section 4.4.1.5 - Figure 20) of the side box. By clicking on the standalone view button (Figure 20 – [2]), a separate tab will open on your browser displaying the ILS. You can use this URL to communicate your ILS to your students or fellow teachers without having to publish it in the Go-Lab repository. The ILS will function fully.

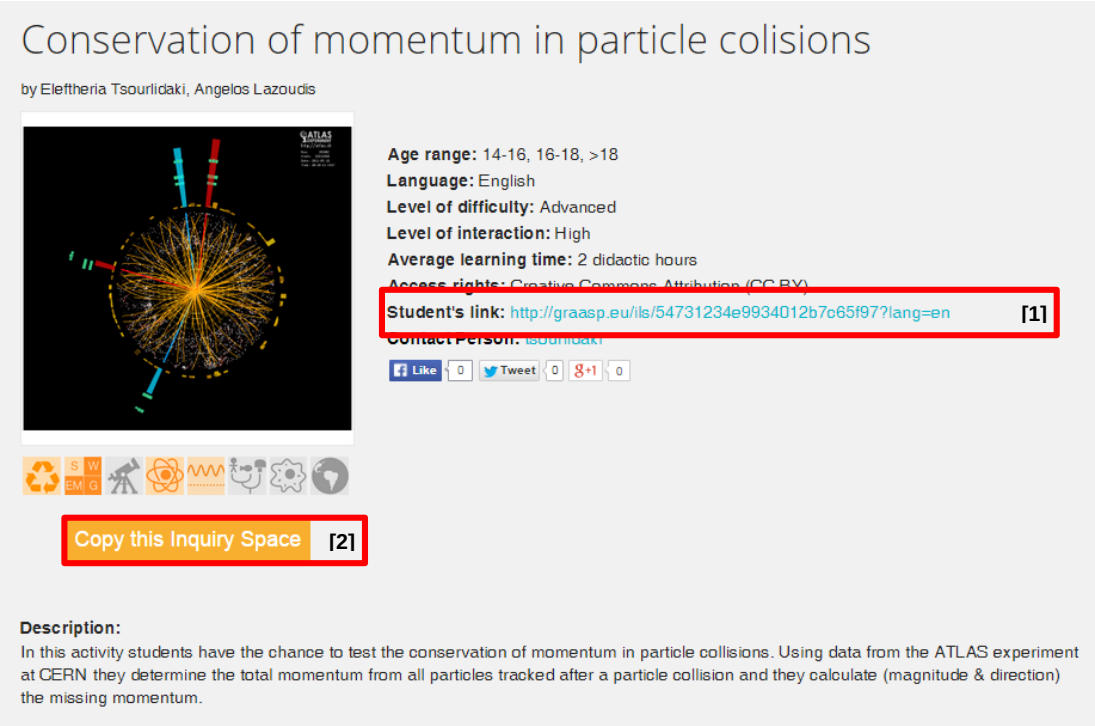


Figure 12: Making use of an existing ILS

4.3 Modify an existing ILS

You may use the cloned inquiry space as is, or you may make any alterations you like (note that the clone is located in your profile, so you are its owner). Section 4.4 below is a step by step guide to all the functions available in the Go-Lab authoring environment, which will help you modify an existing ILS.

In case you make many alterations so that the two ILSs (original and clone) are no longer the same activity you may choose to publish the cloned ILS as a new ILS following the procedure mentioned in section 4.6.

Please note that there is a menu attached to every inquiry space (Figure 13 – [3]), so that you can choose to “Copy” it before altering it. The ‘Copied’ ILS will appear in the form of a thumbnail on your profile page. In this way you can keep both the ‘original’ and any other altered versions of it you make. This is also permits you to use the same ILS with different classes and keep the associated student data separately (see more in section 4.5)

4.4 Create a new ILS

Teachers may create an activity using Graasp and use it with their students. The product of what the teacher makes in Graasp is what the students will be able to see through Go-Lab. As mentioned above, this is called an Inquiry Learning Environment (ILS).

In order to create a new Inquiry Learning Space (ILS) click on the “+” button on the top right corner of the main box in your profile page (Figure 10 – [1]) and select “Create ILS” (Figure 13 – [1]). The “Create Space” option (Figure 13 – [2]) allows you to create an empty sub-space within an ILS.

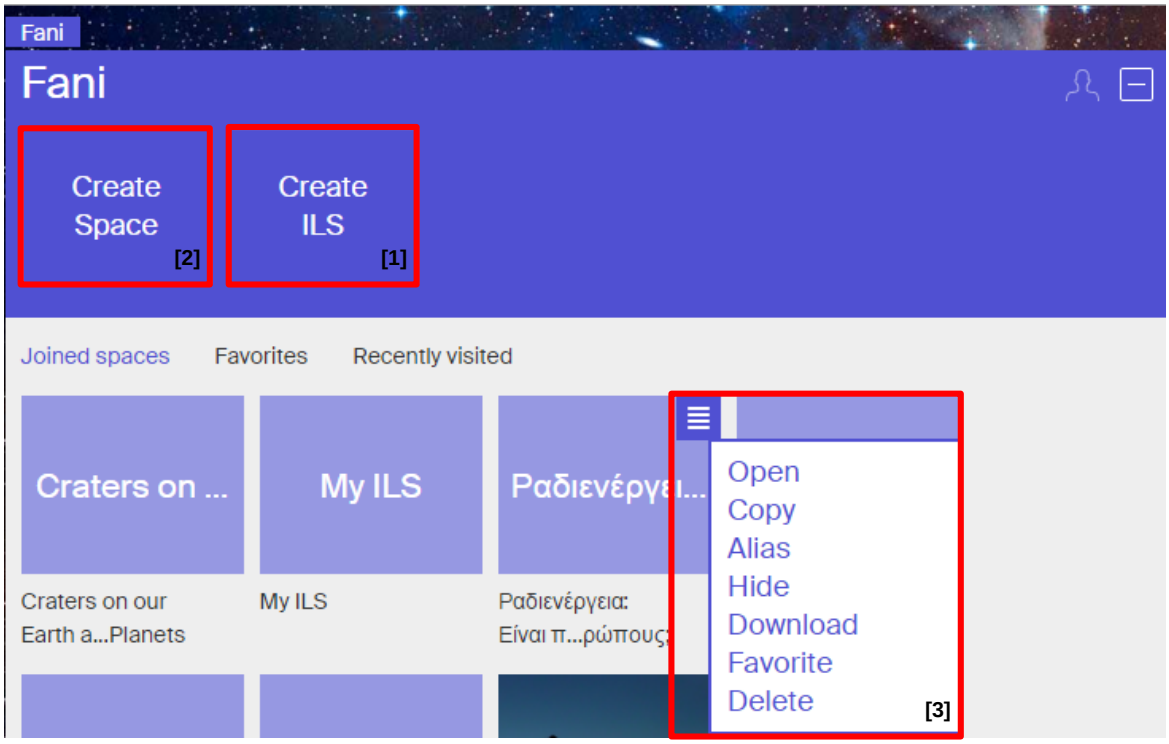


Figure 13: Create a new space or ILS options

After clicking on the "Create ILS" button (Figure 13 – [1]), you need to choose which of the Go-Lab suggested inquiry scenarios (see 'Go-Lab Classroom Scenarios Handbook' - Deliverable D1.4) you would like to use (Figure 14 – [1]), add a name for your ILS (Figure 14 – [2]) (in this case "My ILS") and click on "Create ILS" (Figure 14 – [3]). The new ILS will appear in the form of a thumbnail on your profile page (Figure 11 – [2]).

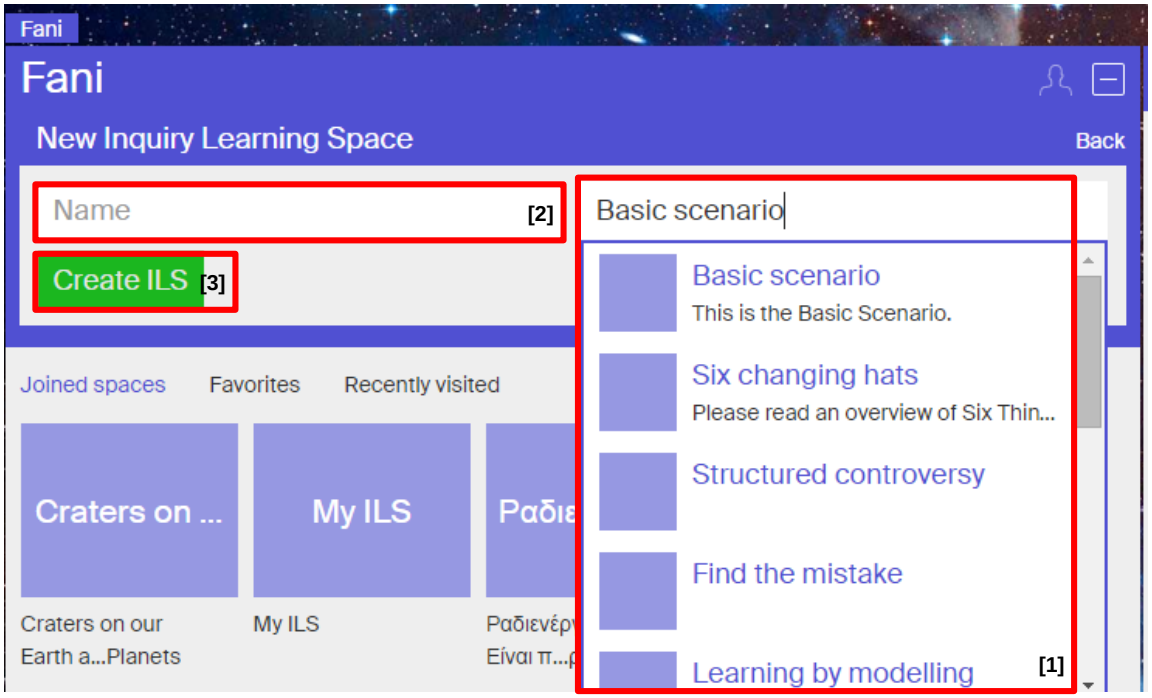


Figure 14: Name your new ILS

Alternatively you may also choose to create an "Inquiry Space" from the Go-Lab Portal. To do so, go to it (http://www.golabz.eu/) select the online lab you wish to use and click on the "Create an Inquiry Space" button (Figure 6 – [7]). In this case, the system will again create an empty

Inquiry Space in your profile page. The difference is that now the lab from which you generated the ILS will appear automatically in the “Investigation” space.

You are now ready to start working on the different phases of the ILS. An ILS in Go-Lab uses the Go-Lab inquiry cycle that has been discussed in Chapter 3. The following guidelines refer to the ‘Basic scenario’ of an ILS. For additional guidance on how to prepare an activity before starting to work in Graasp please check the “Prepare” tab in the “Go-Lab tutorial” section here http://www.golabz.eu/spaces/go-lab-tutorial. Aside from the part that the students see, an ILS may also include additional resources for the teacher (like answer keys), notes and proposals for off-line activities.

Each ILS created in Graasp includes seven sub-spaces (Figure 15 – [1]). The first five of them are the five phases of the Go-Lab inquiry cycle (Orientation; Conceptualization; Investigation; Conclusion; Discussion), and there are two additional called “About” and “Vault”. “About” is the space where you may add some general information about the activity, like a brief description of it and any other related resources. The “Vault” is a space where the data coming from apps are stored (see also section 4.5.2). “About” and “Vault” are by default set not to be visible (Figure 15 – [8])in the standalone view of the ILS, i.e. are “hidden” (see Figure 13 – [3]).

When a teacher sees the ILS s/he has created, within Graasp, in addition to these seven sub-spaces, there is a side box (Figure 15 – [2]) which is not visible to students through the standalone view. There is a different side box for each ILS and for each of its sub-spaces. In addition to other functions, using the buttons in this side box a teacher can add notes, links to additional resources and offline activities, or write comments about the ILS and discuss them with other users. In particular, there are 5 buttons available: Settings, Members, Discussion, Activity and Sharing (Figure 15 – [3]).

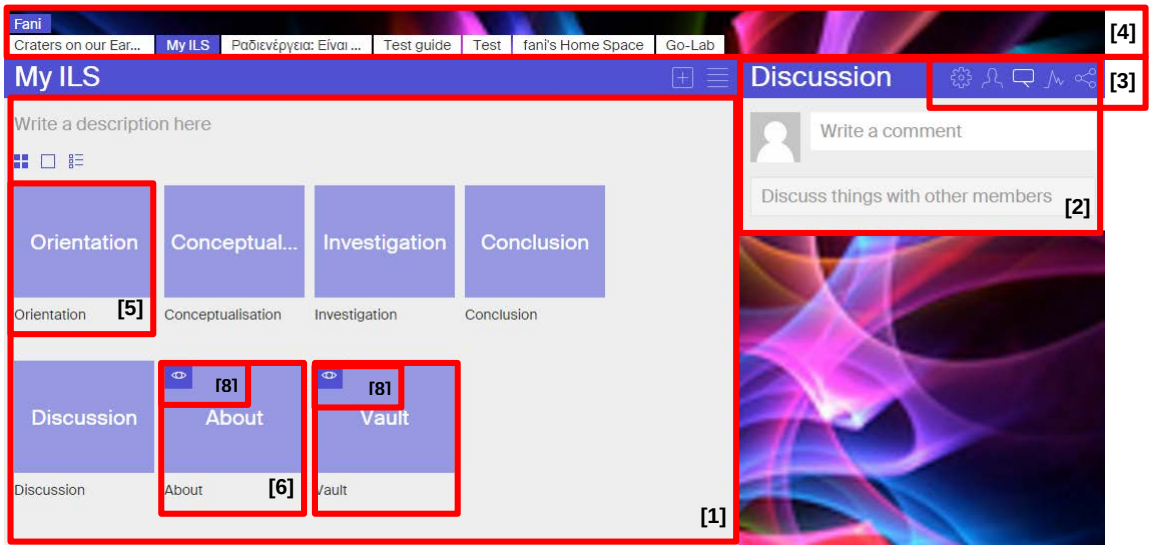


Figure 15: The main area of an inquiry space

4.4.1 General functions for an ILS and for each of its sub-spaces

4.4.1.1 Settings

The gear icon (Figure 16 – [1]) represents the “Settings” function. With this button you can choose to change the name and appearance of the space thumbnail (Figure 16 – [2]) as well as its background image (Figure 16 – [3]).

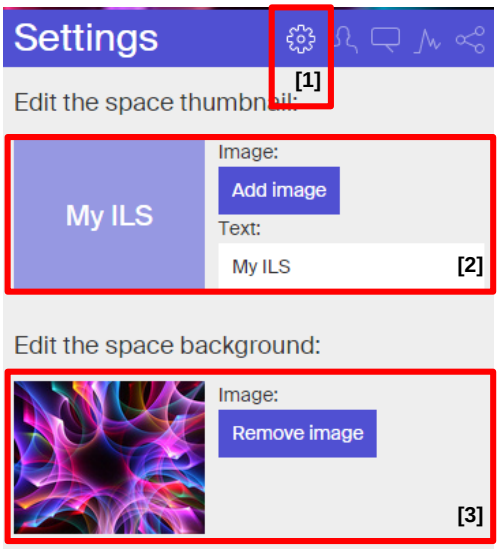


Figure 16: The "Settings" function

4.4.1.2 Members

The avatar icon (Figure 17 – [1]) represents the “Members” function. With this button you can choose to keep your ILS or particular space “Private”, or make it “Public” (Figure 17 – [2]). If a particular space is “Public”, this space will be displayed as one of the Inquiry Spaces in the Go-Lab portal, if it is “Private” only the members of this space can view it through the Graasp authoring environment. You can additionally, choose to “Hide” any space (ILS or sub-space) you have under your profile using the menu attached to it (see Figure 13 – [3]). Only owners and editors of an ILS are able to see it, or see hidden sub-spaces within the ILS. However, any member with a link to a hidden item will be able to open it.

In order to add another member to your ILS, add their Graasp username in the “Add member” section (Figure 17 – [3]). Once a person is added you can choose to change their rights between ‘owner’, ‘editor’ and ‘viewer’ by clicking on their current status which is depicted below their name (Figure 17 – [4]). You can also choose to remove them from the “Members” section.

It should be noted that one of the important goals of the Go-Lab project is to encourage teachers to use, re-use and share their ILSs, and exchange experiences and views on their ease of use and quality.

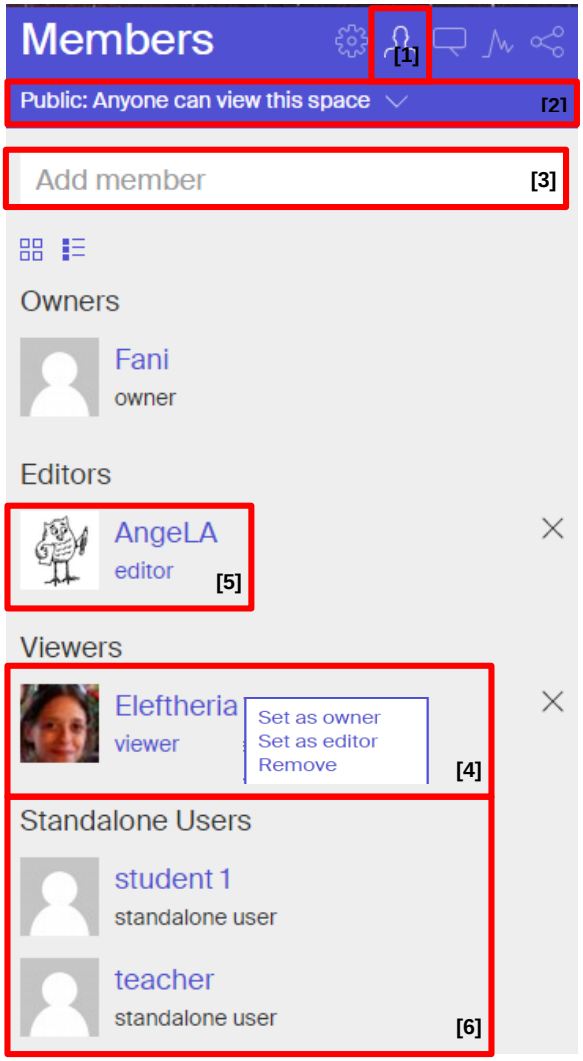


Figure 17: The "Members" function

When you first enter an inquiry space you might notice that besides yourself there is also one more member present called “AngeLA” (Figure 17 – [5]). This is a default user of the system which allows you to keep track of your students’ performance. As long as “AngeLA” is a member of an ILS, it will record any related student activity. You can have access to this information through the monitoring applications of Go-Lab (see section 4.5). If you remove “AngeLA” from an ILS your students’ activity will no longer be recorded.

Finally, after any use of an ILS with students or other viewers, their nicknames will appear using the “Members” function under the “Standalone Users” section (Figure 17 – [6]) (see more in section 4.4.1.5).

4.4.1.3 Discussion

The bubble icon (Figure 18 – [1]) represents the “Discussion” function. To write a comment, type it in the “Write a comment” section (Figure 18 – [2]) and hit enter. In this section you can add notes and tips for other teachers, as well as hyperlinks to additional resources in the form of comments (see e.g. Figure 18 – [3]). As this side function exists for every space, you can add separate notes and resources for each phase of the inquiry cycle.

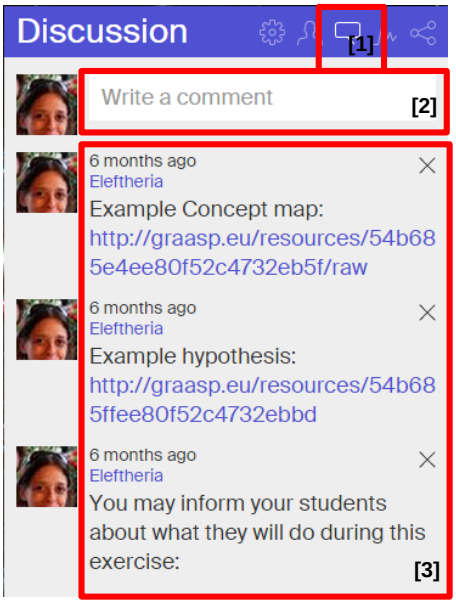


Figure 18: The "Discussion" function

4.4.1.4 Activity

The graph icon (Figure 19 – [1]) represents the “Activity” function. In this section you can see the current activity of all members of the ILS (Figure 19).



Figure 19: The "Activity" function

4.4.1.5 Sharing

The share icon (Figure 20 – [1]) represents the “Sharing” function (Figure 20). This function allows you to share your ILS with your students as well as other viewers.

By clicking on the standalone view button (Figure 20 – [2]), a separate tab will open on your browser asking for a nickname and then displaying the ILS. You can use this URL to communicate your ILS to your students or fellow teachers without having to publish it in the Go-Lab repository. The ILS will function fully. You may change the main language of the labs and apps used in the ILS and the credentials needed for someone to enter the space, by using the standalone view settings (Figure 20 – [3]).

If on the other hand you wish to publish your ILS in the Go-Lab repository you can click on the “Publish Inquiry Space” button (Figure 20 – [4]). You will be then redirected to a separate page that will allow you to add some additional information about your ILS and then publish it (for more information see section 4.6).

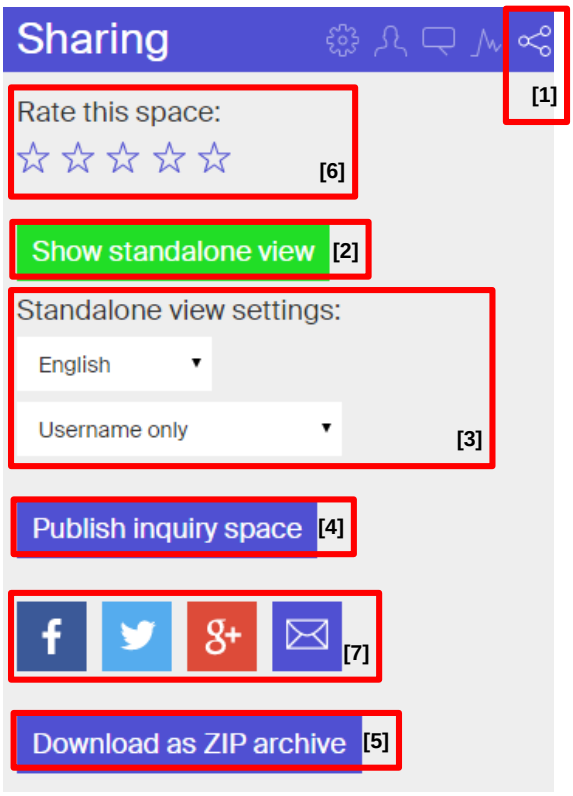


Figure 20: The "Sharing" function

Another option is to “Download as ZIP archive” (Figure 20 – [5]), which allows you to store the ILS in a zip format in your computer.

Finally, you may rate a space by using the star rating system (Figure 20 – [6]) or share it in social media (Figure 20 – [7]).

4.4.2 Building an inquiry phase

Once you have created a new ILS following the steps above you are ready to start working on it. Click on the icon of the ILS you want to work on (in this case “My ILS”) to view the different inquiry phases of the ILS.

The sections below demonstrate how to build a space for a single inquiry phase. In order to complete an ILS you could repeat the same steps for every inquiry phase.

Note that when viewing the central area of an ILS (Figure 15) on the top of the page there is a bar (Figure 15 – [4]) where the titles of all your ILSs are displayed. The ILS you are currently viewing is in blue. You can switch between different ILSs using this tab. In order to get started, click on the first inquiry phase space of the inquiry cycle named “Orientation” (Figure 15 – [5]).

Now, as shown in Figure 21, there are two bars instead of one at the top of the page (Figure 21 – [1]). The top bar displays your ILSs as before while the second bar displays the spaces that are part of this specific ILS. You can switch between spaces using this second bar.

In relation to an inquiry phase space, you may change its name by clicking on it (Figure 21 – [2]); add a brief description (Figure 21 – [3]); and/or drag and drop resources for it (Figure 21 – [4]).

You build your activity by adding different items to it. So let’s say for example, that in this phase the teacher wishes to include some introductory text, then a video, then some more text, then an image, and then a supportive app. These, are three (3) different items (a video, an image and an app) that have to be added. Texts in between items can simply be added in the

description boxes of each item as explained below (section 4.4.3 - Figure 26). In case extra text is also needed this can also be added in the form of a document as explained below (section 4.4.3). In this case the extra text is considered as a separate item. When working in a phase it is advisable to first add all the different items you wish to add and then continue with adding the relevant texts between them.

In order to begin adding items in the Orientation phase you can either use the drag and drop function (Figure 21 – [4]) or click on the "+" button (Figure 21 – [5]).

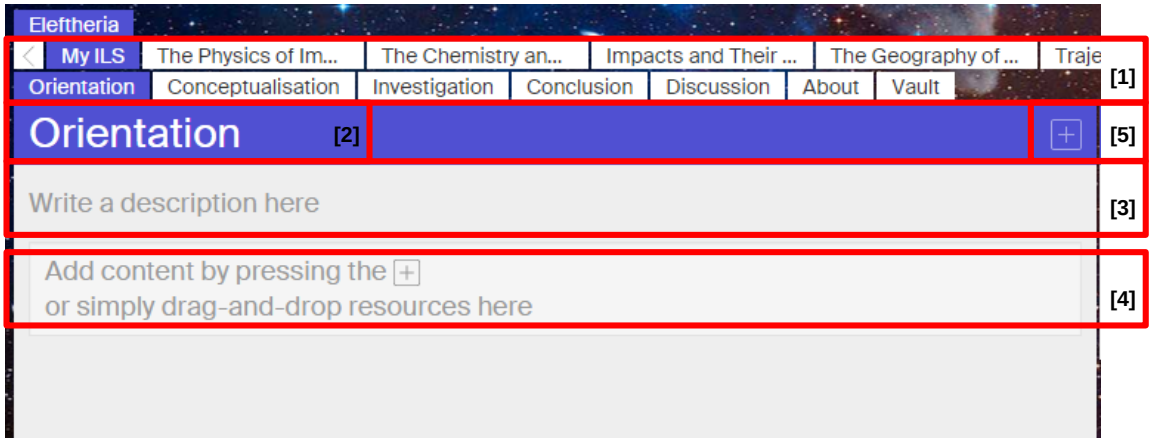


Figure 21: The "Orientation" inquiry phase

Once you click on the "+" button, six different options will appear (Figure 22):

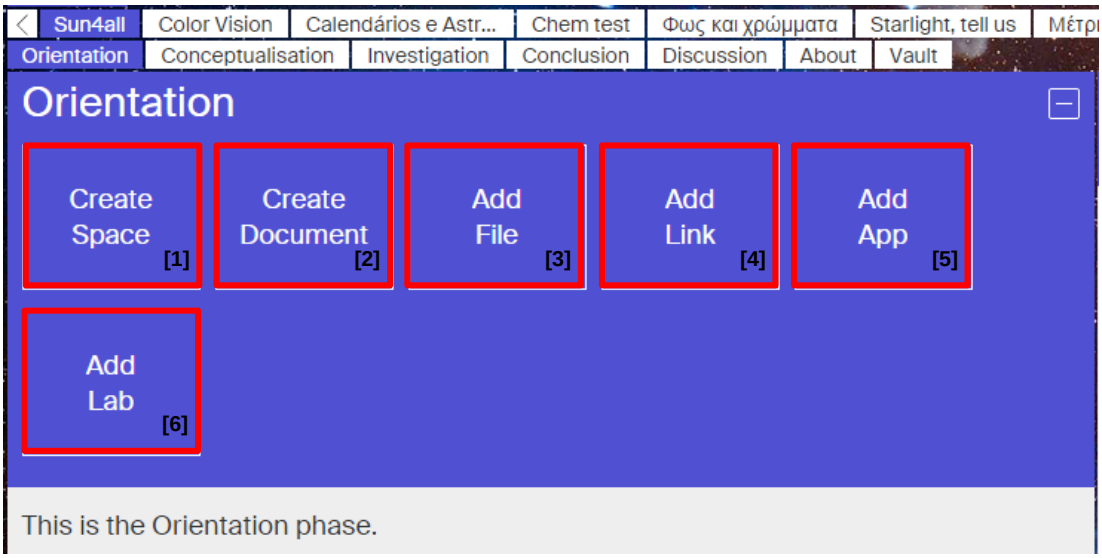


Figure 22: Add item options

- "Create Space" (Figure 22 – [1]) allows you to create a sub-space inside the space you are currently in.
- "Create Document" (Figure 22 – [2]) allows you to create a document which can include texts, links and tables.
- "Add File" (Figure 22 – [3]) allows you to add any kind of other resources, including image and pdf files.
- "Add Link" (Figure 22 – [4]) allows you to add online resources. By adding the URL of a resource using this option, the resources will appear integrated in the space. Examples of such resources can be videos, simple webpages or animations.
- "Add App" (Figure 22 – [5]) allows you to add a supportive app to your ILS either from the Go-Lab repository or from an external source. If you wish to add external apps in

your ILS, keep in mind that the format of such applications needs to have a '.xml' extension.

- Finally, "Add Lab" (Figure 22 – [6]) allows you to add an online lab from the GoLab repository.

4.4.3 Adding content to an inquiry phase

When building a phase the five types of items you will mostly use are documents, files, links, apps and labs. More or less all these types work the same way.

4.4.3.1 Documents

The "Create Document" option (Figure 22 – [2]) allows you to add text anywhere in your space. This option can come in handy when you want to add extra text or tables in-between labs, apps or other resources. Once you click on it, Graasp will ask you to give a name for your document (Figure 23 – [1]) and select between "Rich Text" and "Plain Text" (Figure 23 – [2]). The "Rich text" option will provide you with a text editor; the "Plain text" option will allow you to add other kinds of documents like .txt, .html or .xml documents. When you have selected, click on "Create document".

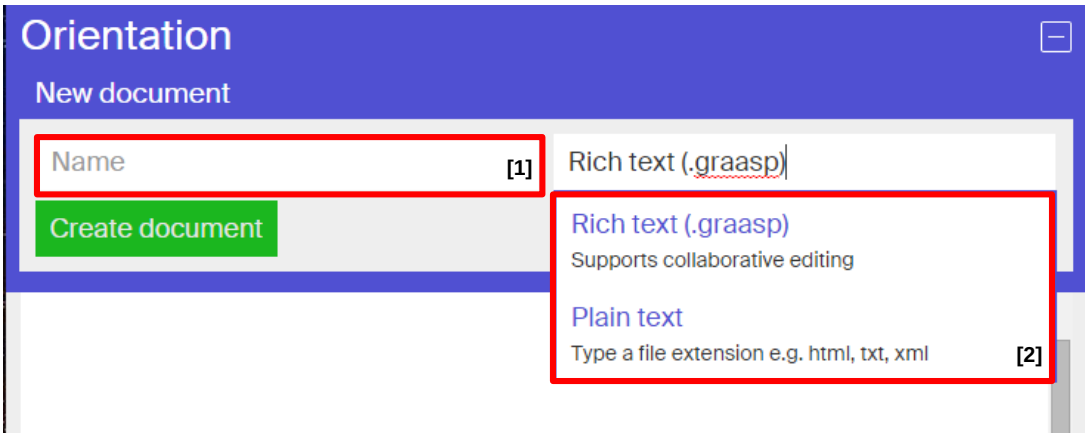


Figure 23: "Create document" option

The document will appear in your space (Figure 24 – [1]). In order to be able to edit this, you will have to switch to the expanded view (Figure 24 – [2], Figure 25) (see section 4.4.4.2).

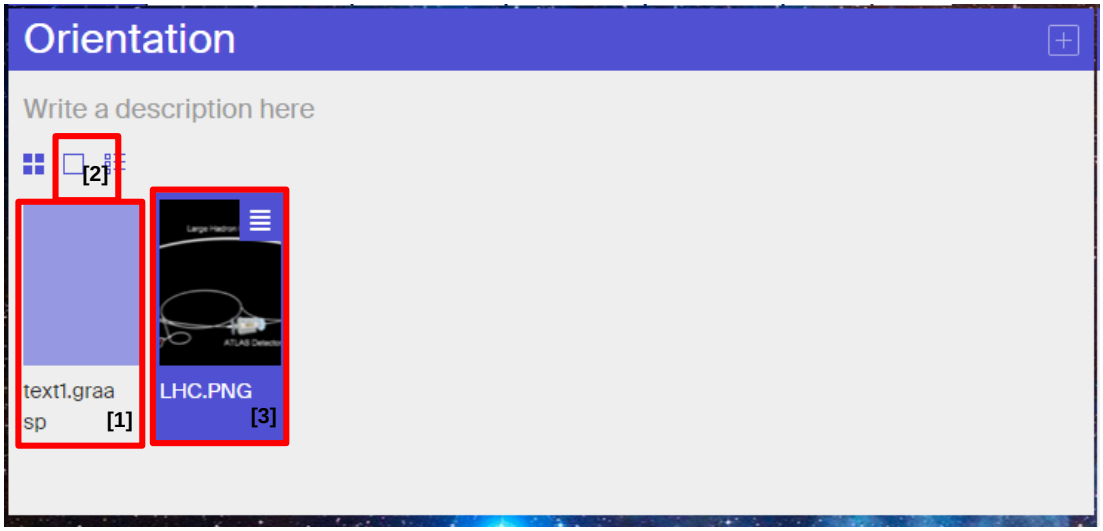


Figure 24: Document added to a space

When in expanded view, in order to use the editor click on “Edit” (Figure 25 – [1]). You can now type your text and use all the functions which appear in the toolbar (Figure 25 – [2]).



Figure 25: Text editor options

Once you finish editing your work, click on “View” (Figure 25 – [3]) to save your work. You can edit your text by clicking on “Edit” again. Please note that the text editor requires you to click on “View” in order to save the text. The description boxes of all items save the text automatically so you do not need to save. Like with any other resource you can move around the text boxes and rearrange their position in the inquiry phase.

As you may have already noticed, each item comes with a description box (Figure 26). Aside from the “Create Document” option, you may also use these description boxes to add texts between items. In these, you can add hyperlinks and style your text using the basic styling functions through keyboard shortcuts.



Figure 26: An item’s description box

4.4.3.2 Files

You can choose to add a file from your computer in your ILS by clicking on the “Add File” option (Figure 22 – [3]). This file could be any kind of resource, such as images, pdf files or animations. Once you click on “Add File”, Graasp will open up a dialog box for you to select the file you wish to upload. Once you select the file, it will be displayed in the space (Figure 24 – [3]).

When it comes to adding items from your computer you may also drag files from their original folder in your computer and drop them in the item section (Figure 21 – [4]). This drag and drop feature can be very handy when you wish to add multiple items; as it allows you to add them all together as a group.

In case you choose to add a file which cannot be displayed in the standalone view the file will appear as a downloadable file (Figure 27). Such files could be for example MS office or Open office documents that cannot be displayed online. Such files can also be added as hyperlinks as it will be explained later on (sections 4.4.3.1).



Figure 27: Notification message for downloadable files

4.4.3.3 Links

If you need to add a resource that is online you can use the "Add Link" option (Figure 22 – [4]). For example let's say you wish to add a YouTube video. Copy the URL of the video and paste it in the "Link URL" box (Figure 28 – [1]). Then click on the "Add Link" button (Figure 28 – [2]) and the video will appear as before, in the form of a thumbnail as part of the corresponding inquiry phase.

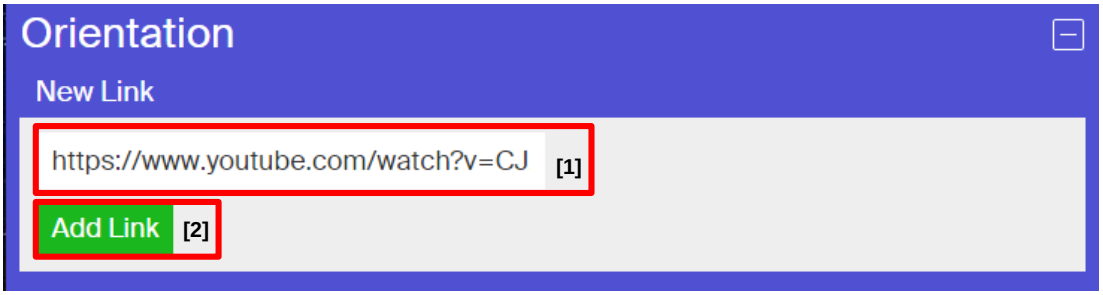


Figure 28: Add an online resource

So far we have added some text, an image, an excel file and a video to our space. So if we now click to see the standalone view from the "Sharing" option (Figure 20 – [2]) of the side box the ILS, this will look as displayed in Figure 29. Note that the description of the video (right above the video) was added automatically from YouTube. You can choose to delete, edit or keep this description as is.

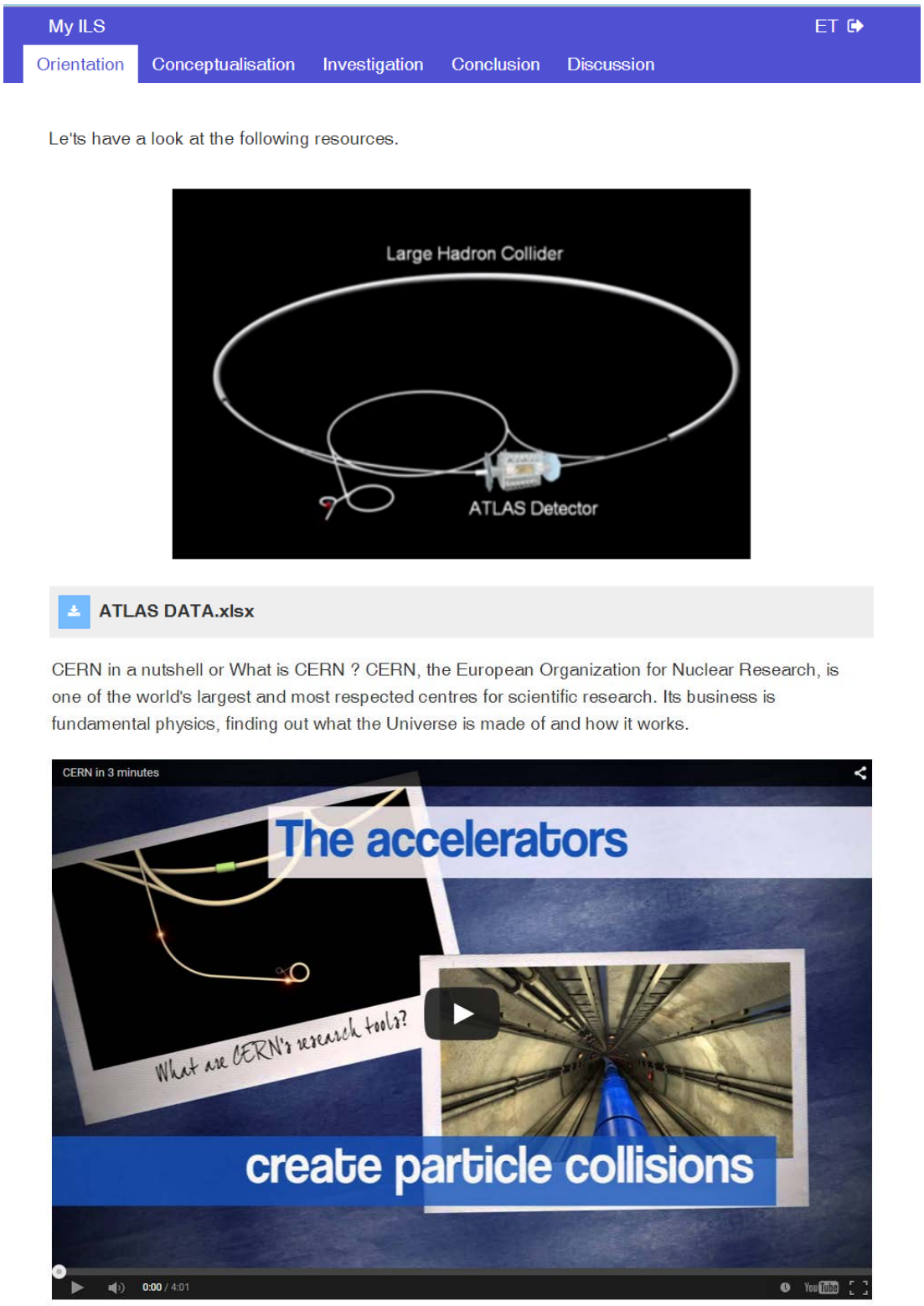


Figure 29: Standalone view of an ILS under construction

4.4.3.4 Supportive Apps

Now let's say you would like to add a supportive app under your video; in this case a concept map. As previously discussed, supportive Apps or simply Apps are web based software applications supporting specific learning or teaching goals and tasks in online labs (see section 3.3). Click again on the "+" button (Figure 21 – [5]) and this time click on the "Add App" option

(Figure 22 – [5]). Then click on the "Select app" space (Figure 30 – [1]) and a list of all the applications available in Go-Lab will appear (Figure 30 – [2]).

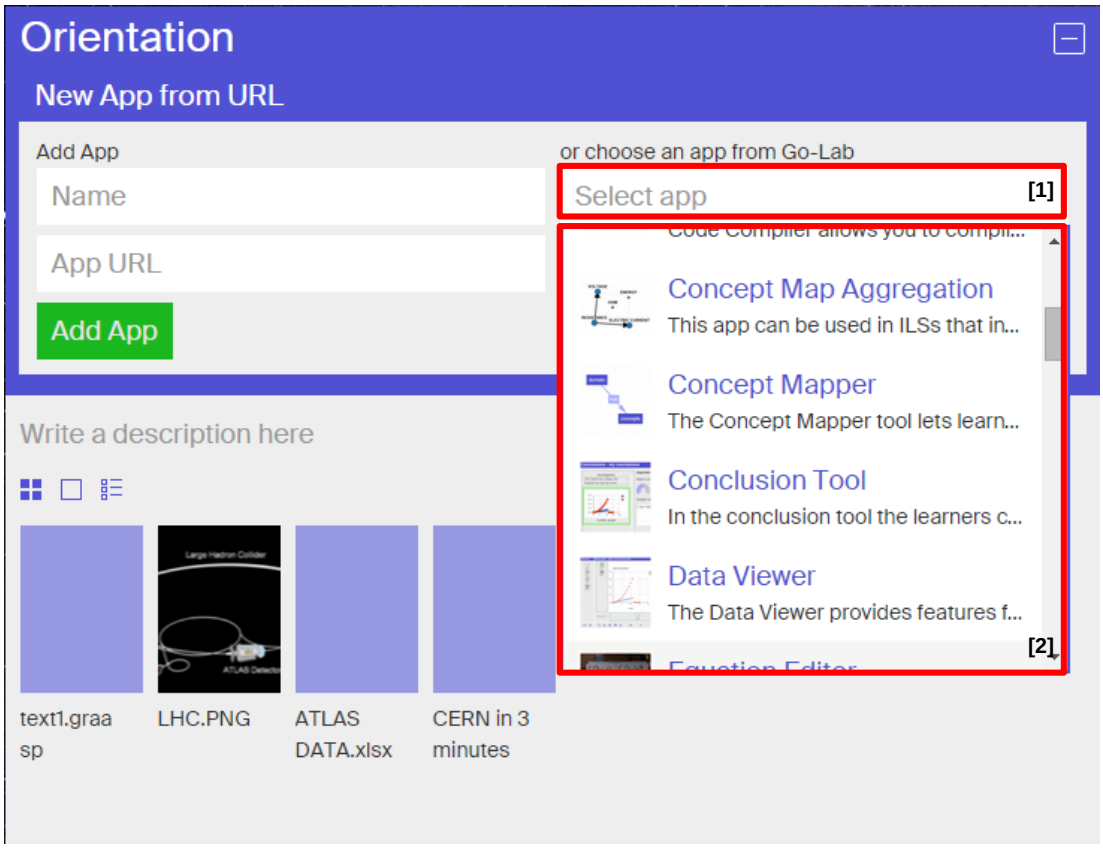


Figure 30: Add supportive application option

Select the app you want. The selected app will now appear next to the thumbnail of the image previously added (Figure 31). If you now click on it, you can access a preview of it and customize its configuration if available and appropriate. Any change in configuration will be carried out in any copy that you may make of this ILS (Figure 32).

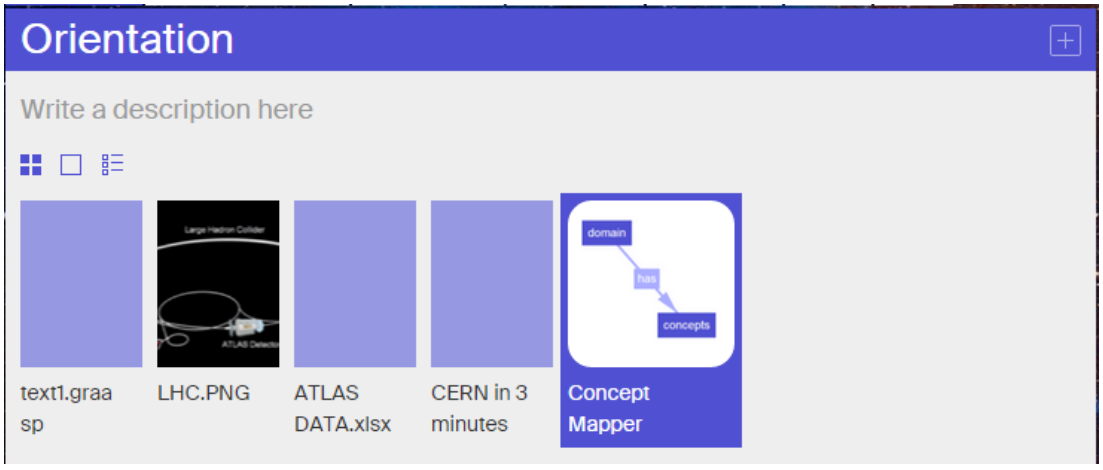


Figure 31: Supportive app added to the Orientation inquiry phase

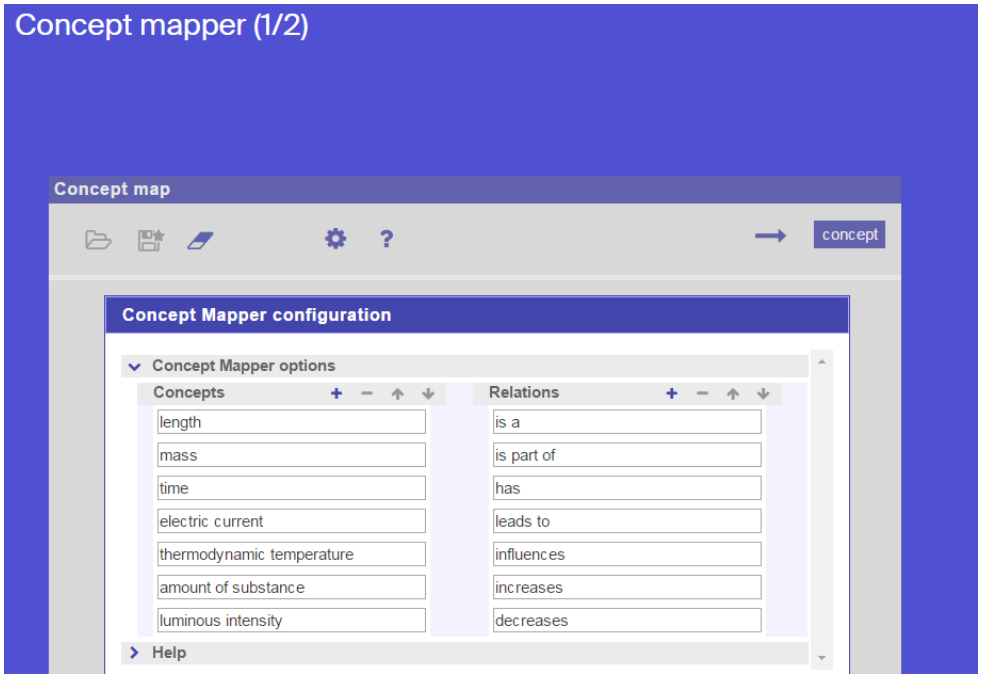


Figure 32: Preview and configuration of a Go-Lab App

4.4.3.5 Online lab

Finally, let's say that after the concept map you also wish to add an online lab. Click on the "+" button again and this time select the "Add Lab" option (Figure 22 – [6]). Click on it and choose the lab you wish from the list (Figure 33) that appears (which includes all the Go-Lab labs).

The inserted lab will now appear next to the thumbnail of the item previously added.



Figure 33: Add online lab option

So now we have added six (6) items, (some text, an image, a downloadable file, a video an app and a lab). In the standalone view, these items will appear one under the other as before (see e.g. Figure 29).

4.4.4 Viewing items in an inquiry phase

While working in Graasp, there are three (3) different ways to view the items of any phase. You can switch between the three options by using the little buttons right under the introductory description of the phase (Figure 34).



Figure 34: Viewing options

4.4.4.1 Thumbnail View

The first option is the thumbnail view (Figure 35 – [1]). In this view you can see all your items as little tiles or thumbnails one next to the other. You can choose to open, move to another phase, alias with another phase, download, add/ remove from favorites or delete any given item by clicking on the top right corner of its thumbnail (Figure 35 – [2]).

You may also rearrange the order of the items by dragging and dropping them to a new place.

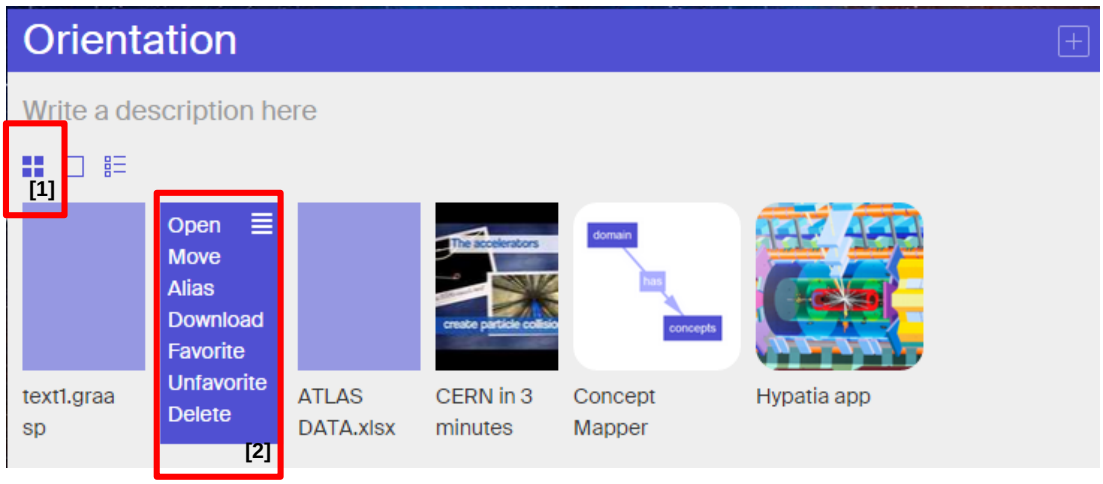


Figure 35: Thumbnail view

4.4.4.2 Expanded View

The expanded view allows you to see all items opened one under the other (Figure 36). This view is ideal when working on the different items of your ILS and especially when adding texts.

As seen in Figure 36, for every item there are: a blue bar (Figure 36 – [1]) on top (not displayed in the standalone view) with the name of the item; a description box (Figure 36 – [2]); and then the item itself (Figure 36 – [3]).

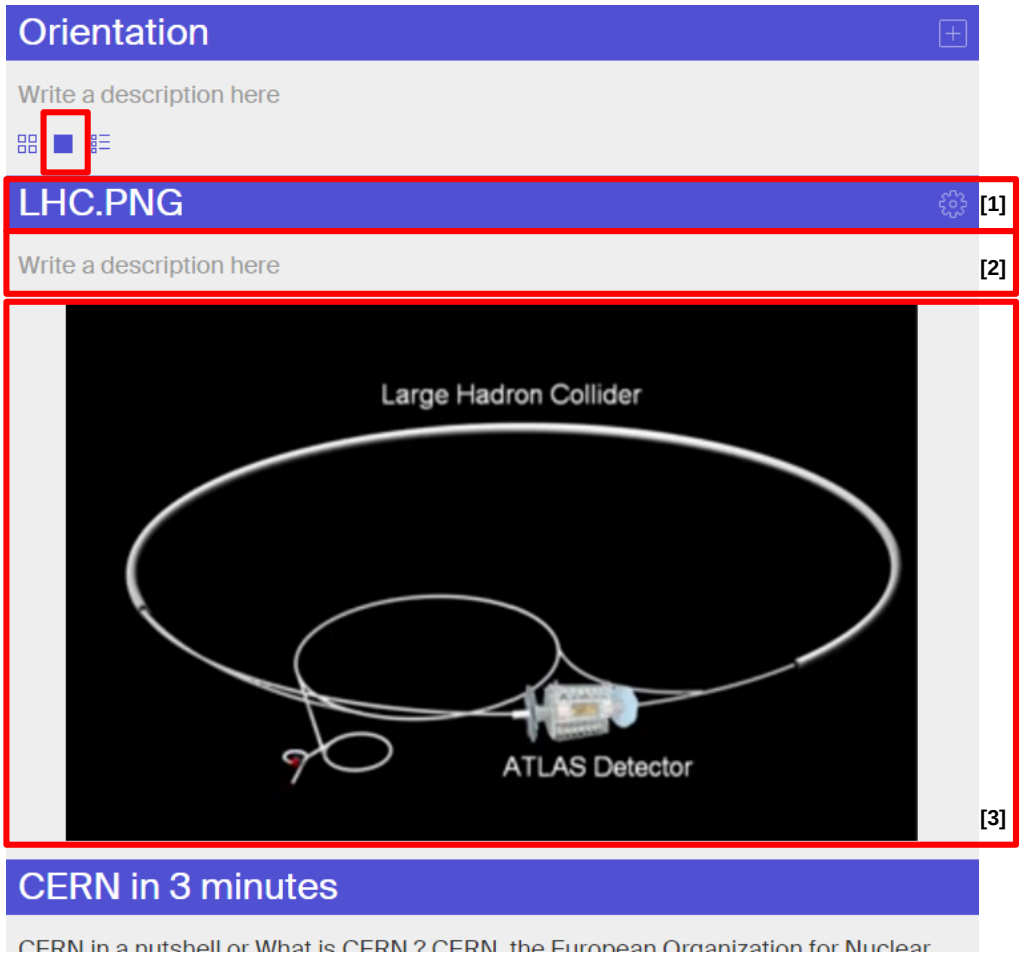


Figure 36: The expanded view

Just like the name of a phase, you can click on the name of an item to rename it.

By clicking on the gear icon on the right you may choose the size of an item (Figure 37).



Figure 37: Change name and size options of an item

4.4.4.3 List View

The list view allows you to view all your items in the form of a list. In this view you can also see the access rights (public or private) in relation to your items (Figure 38).



Figure 38: The list view

4.4.5 Adding resources and notes for the teacher

As mentioned above, you can add notes and resources for teachers using the comments section of the side box and the “About” space respectively (see also section 4.4.5.1). Adding teachers’ notes as well as supportive materials will make your activity much accessible for other teachers to use.

4.4.5.1 Adding resources

You can add resources in any phase of an ILS. However there are cases that a teacher might not wish to have a whole document (a long pdf for example) integrated in a phase but instead s/he might prefer to have it as a hyperlink that can be opened in a separate tab. In addition, a teacher might also wish to add resources that will be accessible only by teachers (for example an answer key). In both these cases, such resources can be added in the “About” space of an ILS (Figure 15 – [6]). Remember that the “About” space is by default “Hidden” so it is not visible to the students through the standalone view. It can only be seen through the Graasp authoring environment by the users that are members of the ILS. In addition, as mentioned in section 4.4.1.2, any space or sub-space created can be ‘hid’, which restricts its visibility only to the owners and editors of the space/sub-space.

To add resources, go to the “About” space of the inquiry phase and use the “Add File” function to add them, or instead use the drag and drop function as described above. Now let’s say that in our example you wish to add a “Related theory” file for the students and an answer key which will be only available to the teacher (Figure 39).

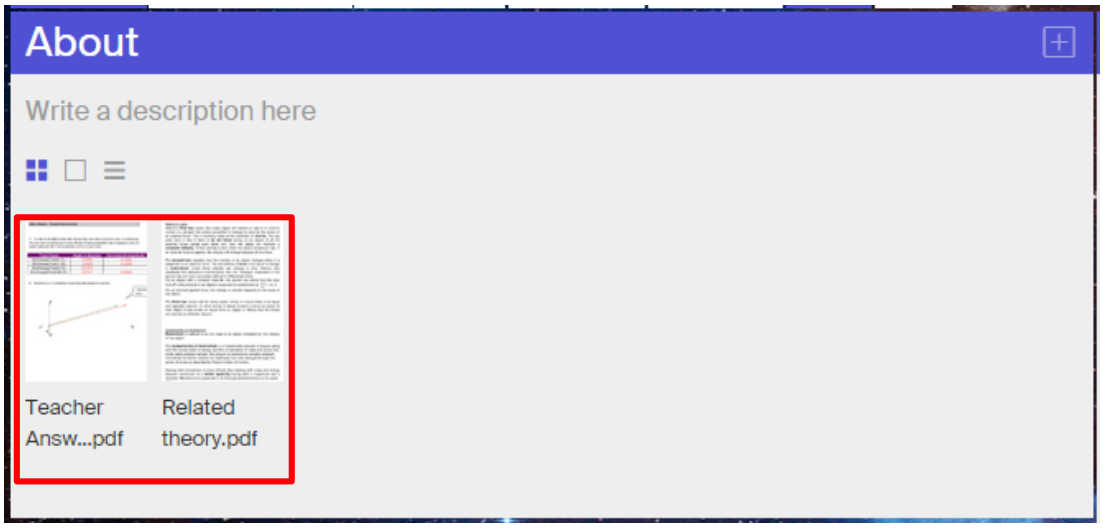


Figure 39: Resources added in the "About" space

Once the files are in the “About” space you can derive a URL for each of these files, so that you can hyperlink them anywhere in the ILS. To do that, while viewing the items using the Thumbnail view click on the resource for which you wish to get a URL. The system will then open up a preview of the resource (Figure 40). Click on the “Raw” button on the top right corner.

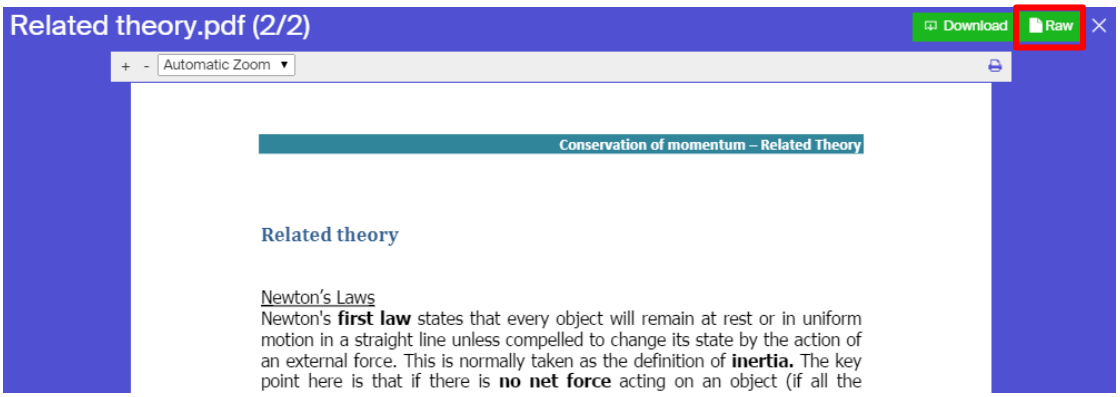


Figure 40: Preview of a resource in Graasp

The resource will now be displayed in a new tab. The link displayed in the browser is the link of the resource. Note that all such links coming from Graasp end in “/raw” (Figure 41). In order to hyperlink this URL anywhere in the ILS, copy the link mentioned above, then go to the phase in which you wish to add it, select the text to which you wish to hyperlink it and use the hyperlink function (Ctrl+K in the case of description boxes and the “Insert link” button in the case of the text editor).

If you wish to have the resource available only for teachers there in no need to do anything else. As long as the document is in the “About” space, all the teachers, members of the ILS, will have access to it.

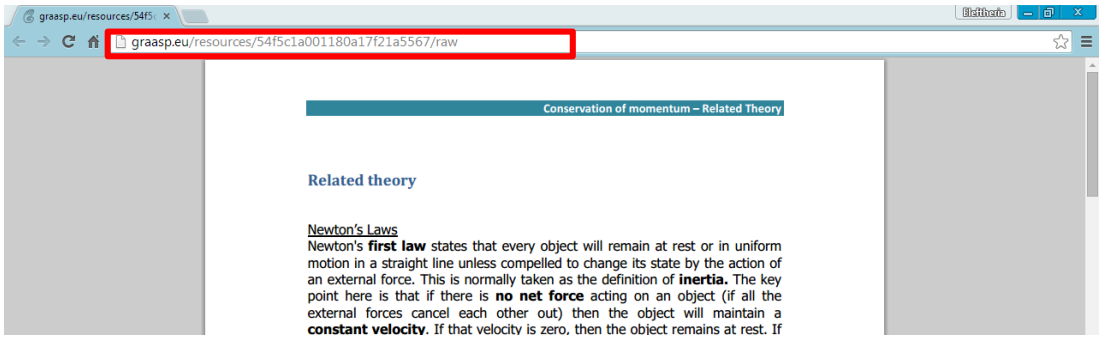


Figure 41: Raw resource displayed

4.4.5.2 Adding notes

Notes for teachers are an essential part of an ILS especially in the case we expect many teachers to use it. Notes for teachers might include suggestions for offline activities, tips and tricks and comments based on a teacher's past experience with this ILS. You can add notes in any phase of the ILS using the "Discussion" option from the side box. Simply type your note and hit enter (Figure 42 – [1]).

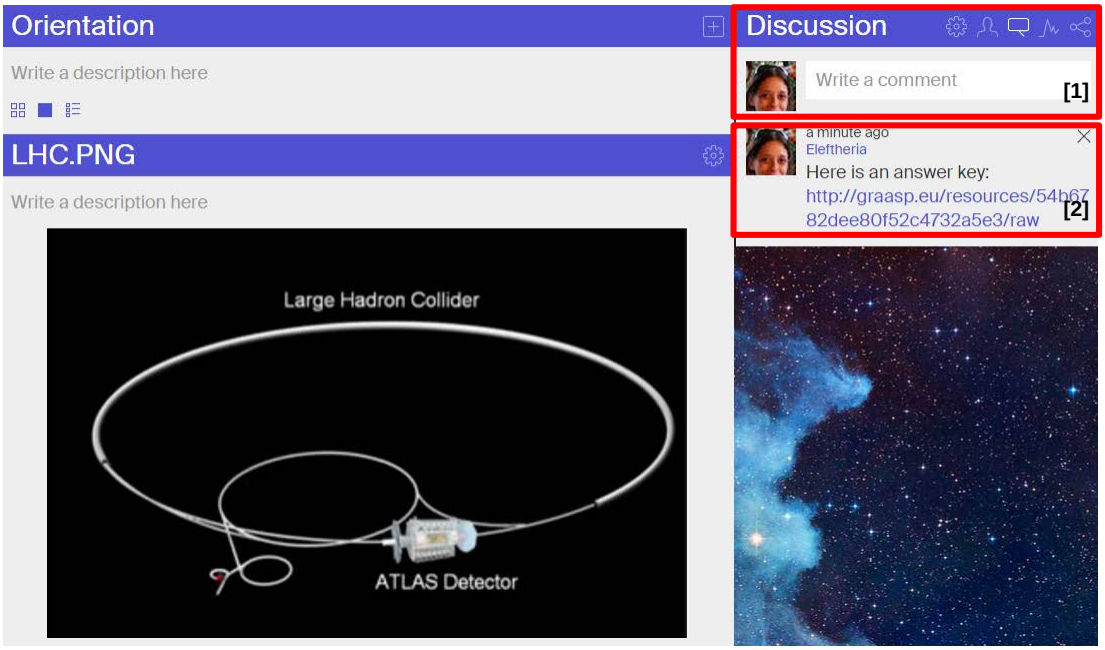


Figure 42: Add teacher notes

Note that if you add URLs in this section the system will automatically add a hyperlink for them. Thus you may as well copy the link of a resource from the "About" section as described above and paste it in the comments section for other teachers to find (remember that this section is not visible by the students) (Figure 42 – [2]).

You may alternatively use the option "Create Document" (Figure 22 – [2]) to write your teacher notes and then hide the document, so that it is not displayed in the standalone view, but be accessible to other teachers / editors of the ILS.

Consequently, teachers do not have access to all additional resources only through the "About" section, but they may also find them next to the inquiry phase in which they are meant to use them.

4.5 Monitoring student outcomes

4.5.1 Using monitoring apps

As mentioned in 4.4.1.2, every ILS has a default member called “AngeLA”. As long as “AngeLA” is a member of an ILS, the system will keep track of students’ activity. You can have access to the tracking records by adding to your ILS the respective supportive apps from the Go-Lab repository. You can add these supportive apps in a ‘hidden’ space in your ILS so that only the members of the ILS can have access to them (unless for some reason you wish your students to have access to these monitoring apps as well). Given that by default the “About” space is “hidden” you can add these apps there. Alternatively you may create a new space, which can set to “Hide”, and add the apps there so you can have them separately from other items. To do that, go back to the main area of your ILS, click on the “+” button and select the “Create Space” option (Figure 13 – [2]).

Add the name you wish for this space (in this case “Monitoring”), click on the green “Create Space” button and the new space will appear right next to the “Vault” space (Figure 43).

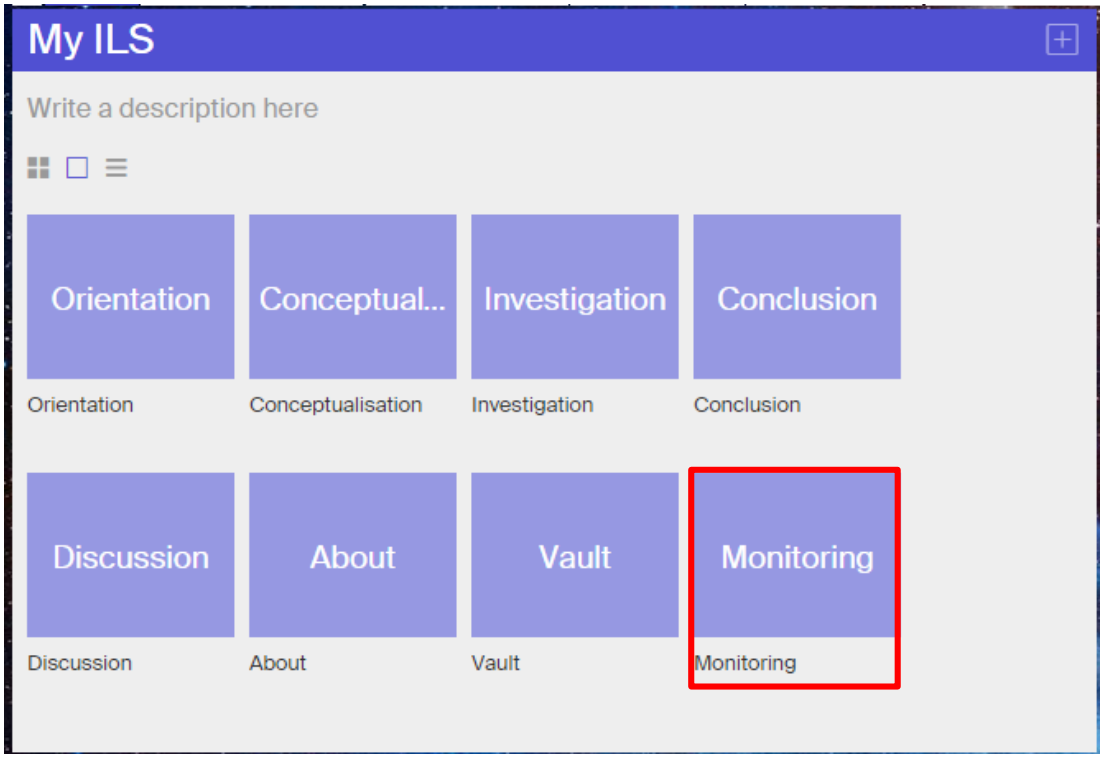


Figure 43: New sub-space added to an ILS

Enter the “Monitoring” space which from its top right menu can set to “Hide” (unless you wish your students to have access to this space through the standalone view).

Now it is time to add the monitoring apps. Following the procedure described in section 4.4.3.4, add the following apps (any or all) from the Go-Lab repository:

- Action Statistics
- Online users visualization
- Student time spent

The “Action statistics” app visualizes the number of actions of the users in an ILS per app as a multivariate bar chart (Figure 44). Users can adapt the visualization by filtering for apps and by altering the visual representation.

The “Online users’ visualization” app shows for every phase in an inquiry space which users are currently active in that phase (Figure 45). The user is shown with his profile picture or the first letter of his name. The visualization is updated in real time.

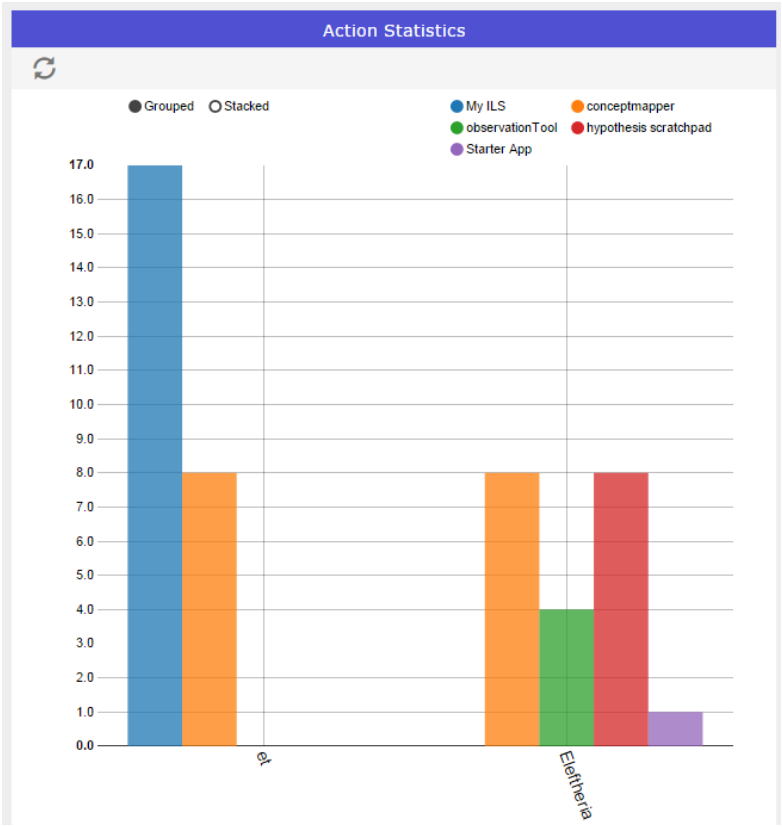


Figure 44: "Action statistics" supportive application

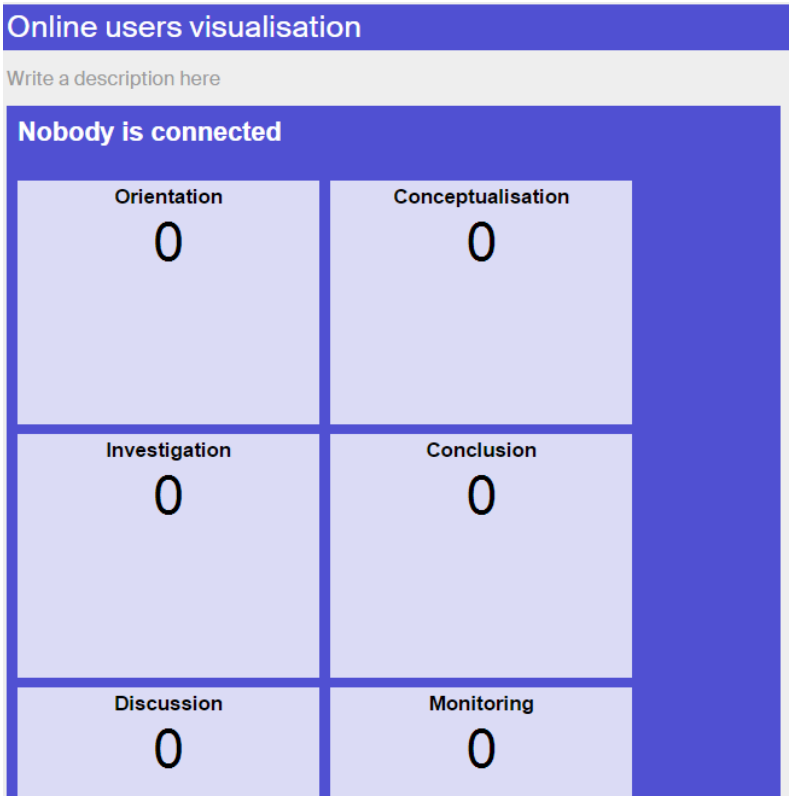


Figure 45: "Online users’ visualization" supportive application

Finally the “Student time spent” app displays a table with the time spent for each student in each phase of an inquiry space (Figure 46). The time spent is updated in real time for each user and phase.

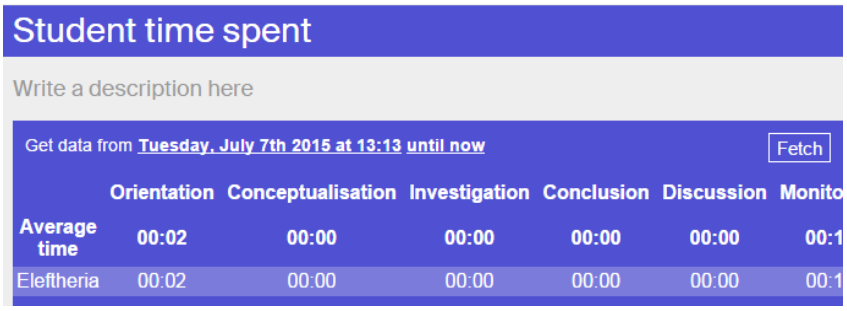


Figure 46: "Student time spent” supportive application

4.5.2 Using “Vault” sub-space

Another way to monitor your students is through the “Vault” space (Figure 15 – [7]), which is literally the vault of the ILS. All data that are inserted by the students in any of the supportive apps (in all phases) of the ILS are automatically stored in the Vault. Thus teachers can later have access to all the materials created by all their students (Figure 47).



Figure 47: The “Vault” after running an ILS

4.5.3 Monitor a student's individual work

Finally, you can monitor individual students' outcomes (if you know the nicknames they have used in accessing a specific ILS) by using the "Members" function in the side box of Graasp and clicking on their nicknames appearing under the "Standalone Users" section (Figure 17 – [6]). Once you do this for a nicknamed student, a new tab will open on your browser showing the complete ILS this student has worked on, with all the input and answers s/he has given to the apps and questions of the ILS respectively.

4.6 Publish your ILS

To publish your ILS click on the "Publish inquiry space" button in the "Sharing" section of the side box of your ILS main area (Figure 48 and Figure 20 – [4]).

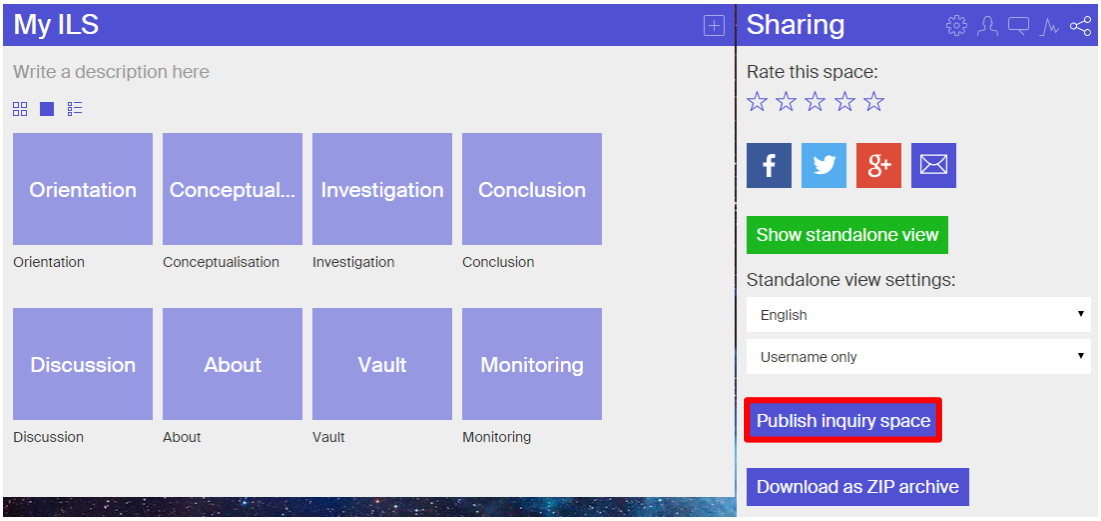


Figure 48: Publish ILS option

The system will redirect you to a new page (you might be asked to re-login first) called "Create Inquiry Space" (Figure 49) in which you can add some basic information for your ILS and then publish it in the Go-Lab portal.

You might notice that many of the fields are pre-filled. The information in these is derived from the lab which you have used in your ILS. You may choose to alter these fields if you wish. Once you fill in all the necessary information in all of the four (4) tabs of the "Create Inquiry Space" page (Figure 49 – [1]) click on the "Save" button at the bottom of the page (Figure 49 – [2]). Once you are done the ILS will appear in the Go-Lab portal and will be available to all users of the Go-Lab repository.

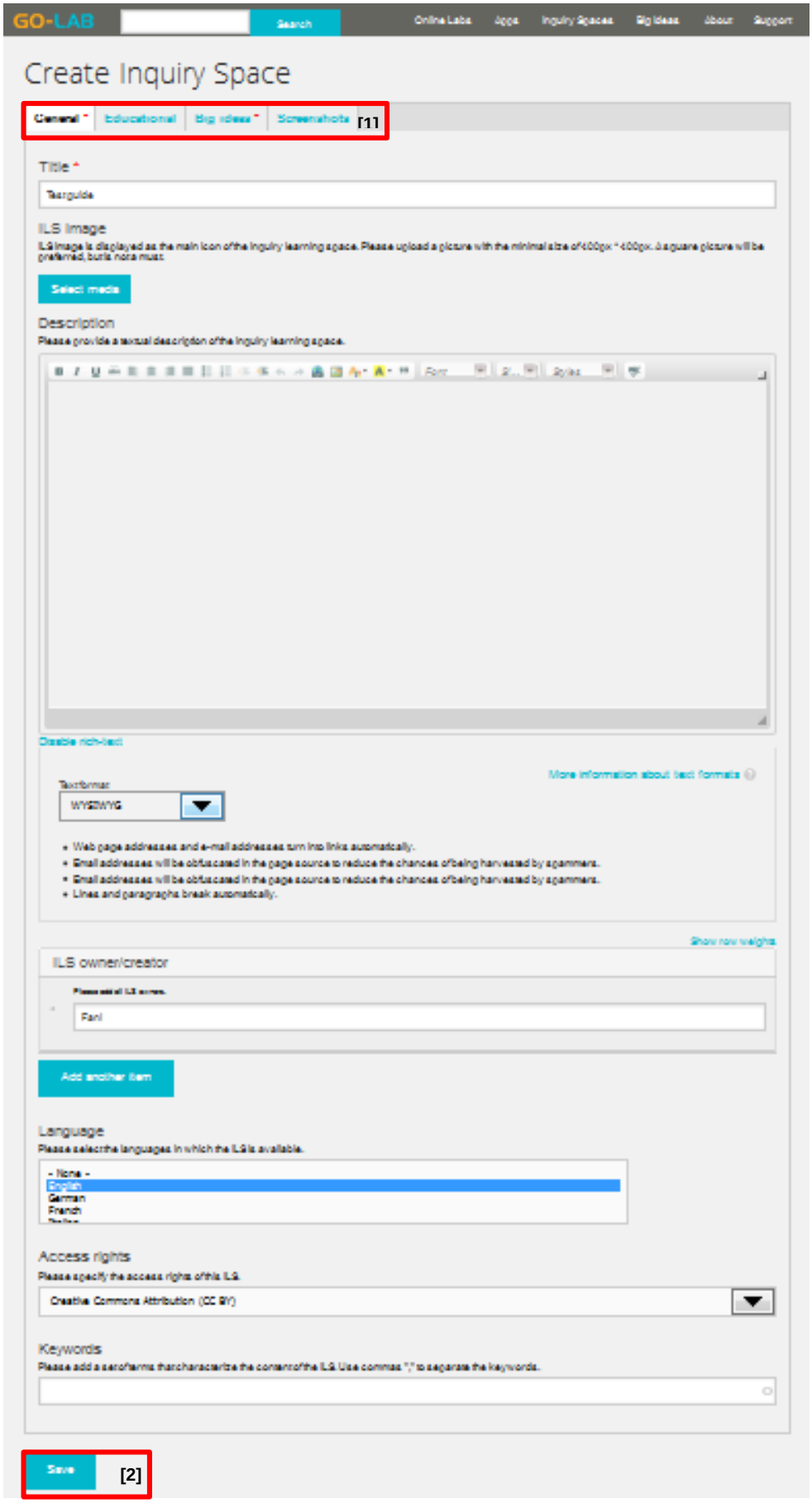


Figure 49: ILS publish form

5 Online Teacher Support

One of the important features of the Go-Lab portal (or 'GoLabz') is the support services and access to peers, communities and scientists it offers to teachers to facilitate their use of the Go-Lab learning environment and uptake of inquiry learning activities in the classroom (http://www.golabz.eu/support).

By clicking on the "Support" button on the home page of 'GoLabz' (Figure 2 – [5]), a new tab will open in your browser (Figure 50), with links to the following support resources and services for teachers – users of the Go-Lab learning environment:

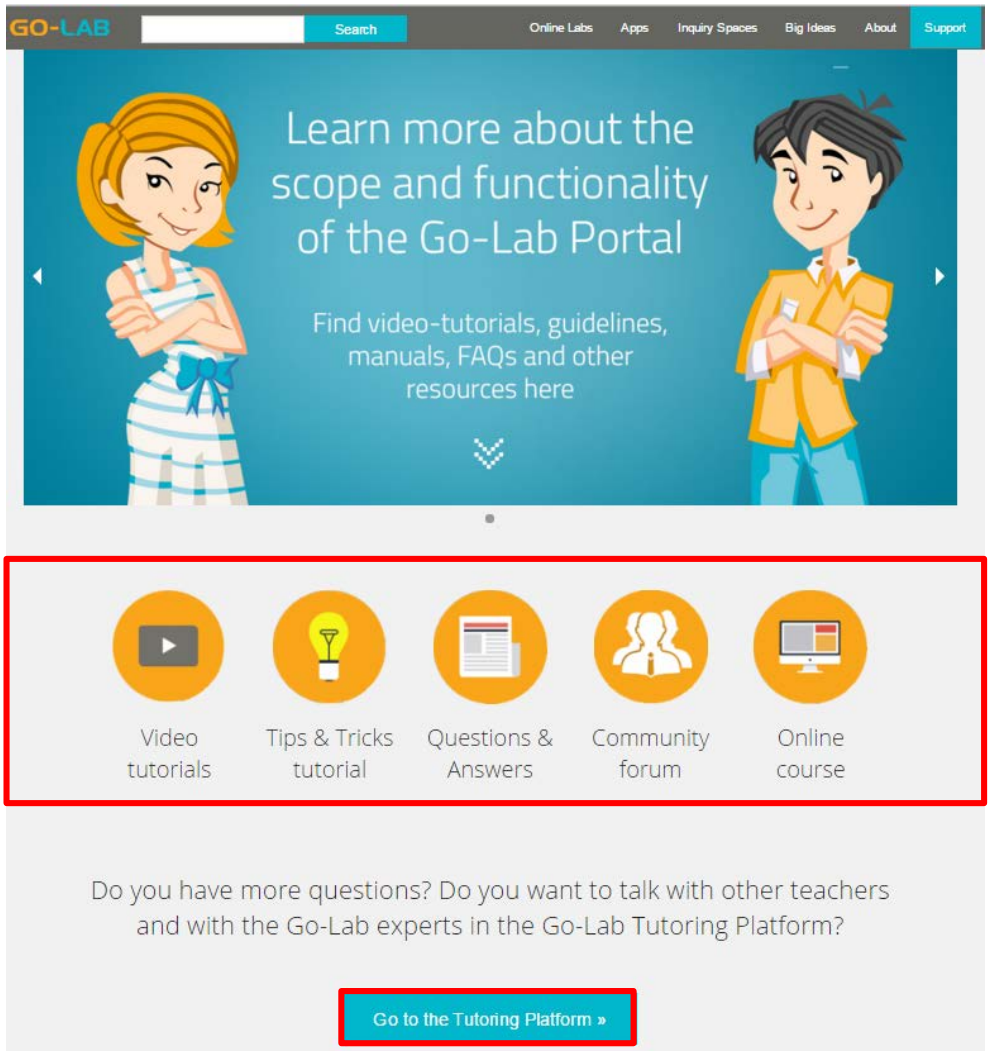


Figure 50: Go-Lab online teacher support

- Video tutorials
- Tips & Tricks tutorial
- Questions & Answers
- Community forum
- Online course
- Tutoring Platform

The following sections will describe the scope of each of these provisions.

5.1 Video tutorials

The “Video tutorials” link will take you to a page (Figure 51) on a new tab in your browser, where you can find the following tutorial videos:

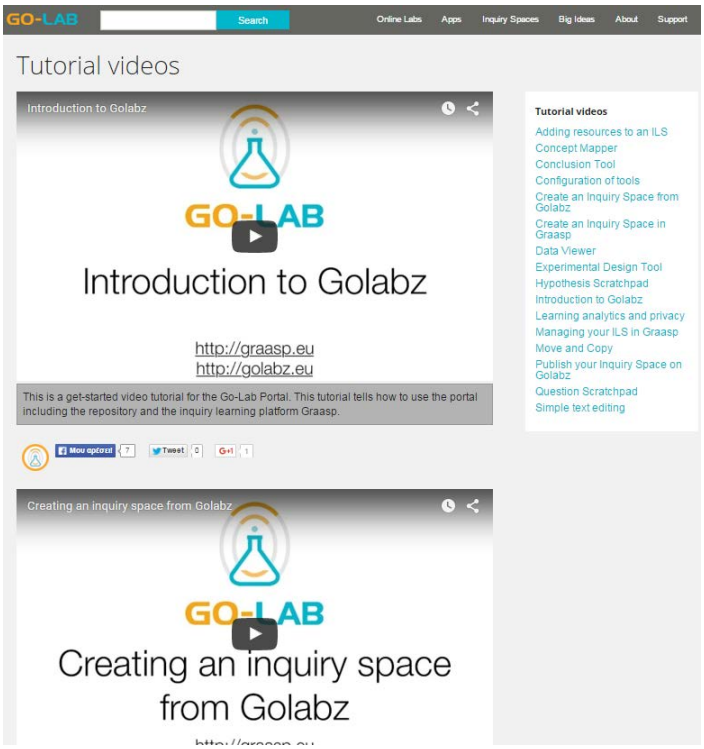


Figure 51: Go-Lab tutorial videos

- Adding resources to an ILS
- Concept Mapper
- Conclusion Tool
- Configuration of tools
- Create an Inquiry Space from Golabz
- Create an Inquiry Space in Graasp
- Data Viewer
- Experimental Design Tool
- Hypothesis Scratchpad
- Introduction to Golabz
- Learning analytics and privacy
- Managing your ILS in Graasp
- Move and Copy
- Publish your Inquiry Space on Golabz
- Question Scratchpad
- Simple text editing

5.2 Tips & Tricks tutorial

The “Tips & Tricks tutorial” link opens up a new tab on your browser, with a page containing brief advice about particular issues that you may need help with (Figure 52), such as:

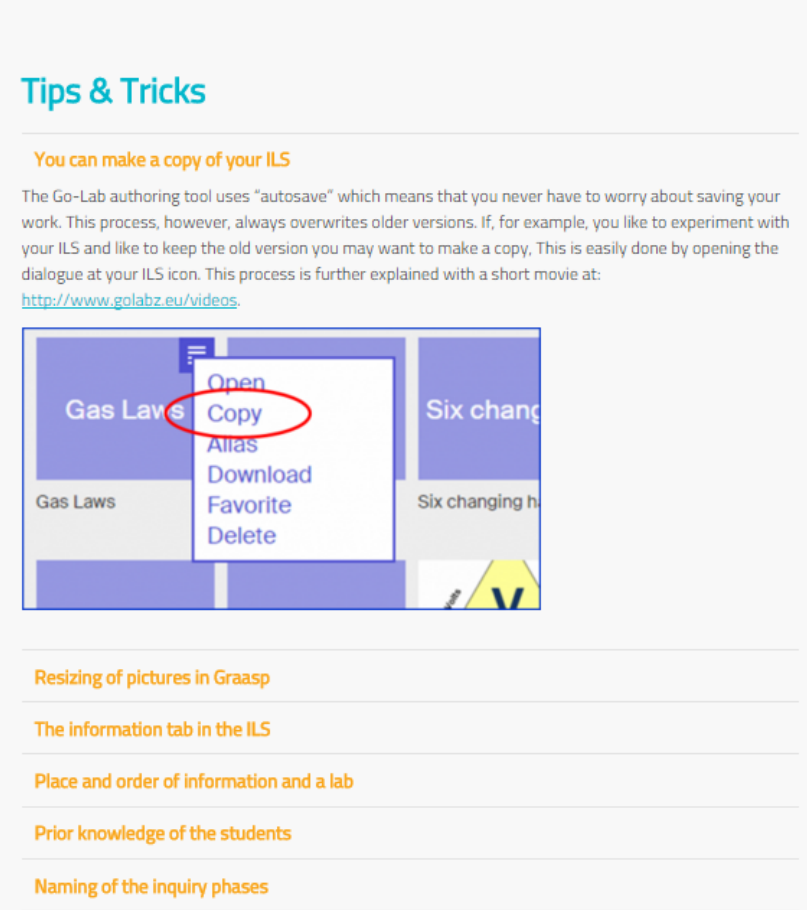


Figure 52: Go-Lab Tips & Tricks

- You can make a copy of your ILS
- Resizing of pictures in Graasp
- The information tab in the ILS
- Place and order of information and a lab
- Prior knowledge of the students
- Naming of the inquiry phases
- Domain specific tools
- Explanation of Go-Lab tools
- Go-Lab tools have a help function
- Inquiry is more than a step of prescribed steps
- You can change the phases of the inquiry cycle
- The length of an inquiry phase
- Transition between inquiry phases
- Explaining an inquiry phase
- Media use in the ILS
- Number and length of videos
- Conclusion phase
- Use of questions
- When introducing Questioning/Hypothesis Scratchpad, get back to these in later phase
- Use different background images for different phases
- Choose your own language
- Do not underestimate the time it takes to complete an ILS

- Not all students need the same amount of guidance
- You can cooperate with colleagues when designing an ILS

By clicking onto any of these issues (links), a brief elaboration of the issue opens up underneath; this can contain text, images and/or weblinks. An example for the issue 'You can make a copy of your ILS' can be seen in Figure 52.

5.3 Questions & Answers

The "Questions & Answers" link opens up a new tab on your browser directing you to a page where you can find a list of Frequently Asked Questions (Figure 53). By clicking on to any of these, a short text appears with its answer. For example, see in Figure 53 the answer to the question 'What is inquiry learning?'. The questions currently listed on the webpage are sorted in 3 categories, depending on whether they are:

- general questions about the Go-Lab project;
- questions about the inquiry learning spaces and online labs;
- or technical questions.

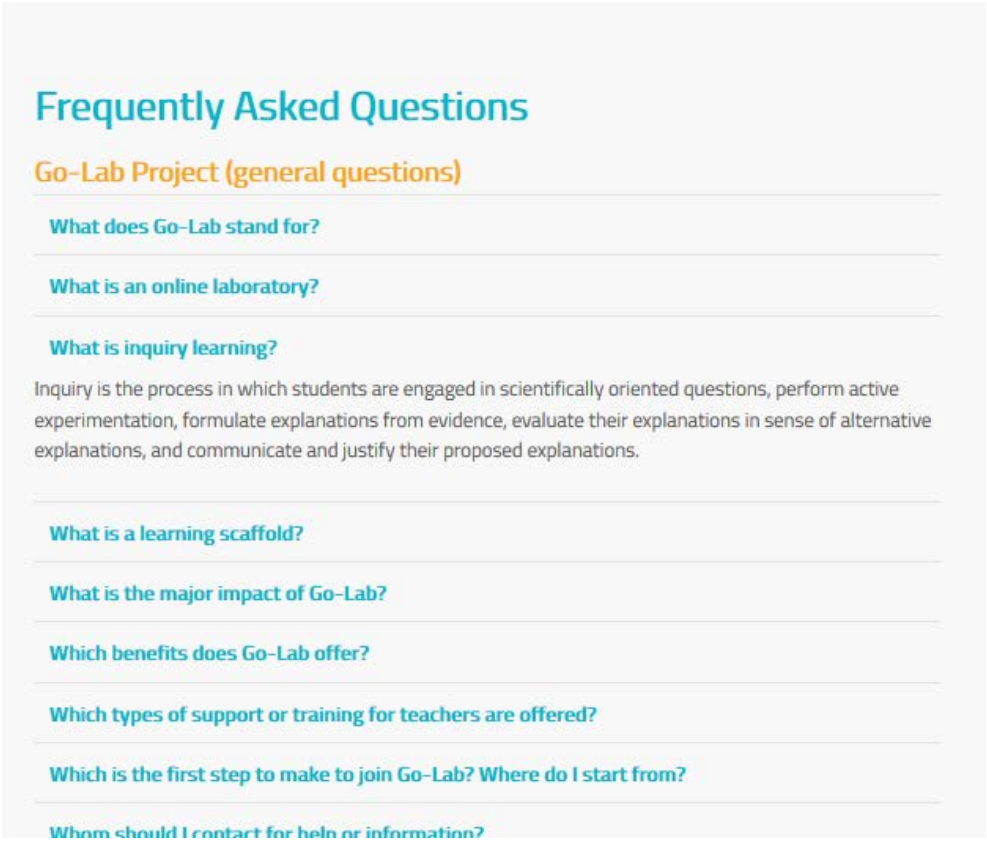


Figure 53: Go-Lab Questions & Answers

Examples of these questions under each of these categories include:

Go-Lab Project (general questions)

- What does Go-Lab stand for?
- What is an online laboratory?
- What is inquiry learning?
- What is a learning scaffold?
- What is the major impact of Go-Lab?

- Which benefits does Go-Lab offer?
- Which types of support or training for teachers are offered?
- Which is the first step to make to join Go-Lab? Where do I start from?
- Whom should I contact for help or information?
- My country is not listed in Go-Lab. Can I join?
- I am not a science teacher, but I want to use Go-Lab authoring tools and some apps. Can I do that?
- What will happen to golabz.eu, labs, apps, and ILSs after the end of the project?
- I am a pre-service teacher, am I eligible to join Go-Lab?
- My school's principal expressed concerns about issues such as privacy of students, personal data protection etc. What should I answer to him/her? Is there an official policy statement on these?

Inquiry Learning Spaces and Online Labs

- What does ILS stand for?
- How do I publish an ILS?
- I am developing an ILS and I made a mistake. Can I find a previous version of it?
- How do I share an ILS with fellow teachers?
- I have an online lab which is not included in golabz.eu. Can I use it in my ILS?
- How can I propose a new online lab to be included in golabz.eu?
- Are the proposed inquiry phases the only inquiry model I have to use in my ILS?
- Can I print out my full ILS, so I can work on it in paper offline?
- When I copy an ILS and then alter it, do I have permission to publish the new one with my name as author?
- What is the difference between an owner and an editor of an ILS?
- I do not find an answer to my question, whom should I contact, what should I do?

Technical Questions

- I am a teacher and want to develop a remote lab, where do I start from? Where can I find technical specifications, guidelines or support?
- What is the maximum number of students that can use my ILS at once?
- Which browsers and operating systems are better supported or recommend to use?
- Are tablets and smart-phones supported?
- In my ILS I have an external web-link. How can I make it to open in a new browser window (or make it to open within the ILS)?
- What is the difference between an owner and an editor of an ILS?
- I do not find an answer to my question, whom should I contact, what should I do?

5.4 Community forum

The "Community forum" link opens up a new tab on your browser, with the existing discussion forums. In Figure 54 you can see a 'General discussion' forum and a 'Technical discussion' forum. By clicking on either of these you are taken to a new page, which has a list of the discussion topics in the corresponding forum and the number of contributions to each. You can read any of these contributions, or you can use the search facility on the right to look for a particular topic. However, in order to post new content in a forum, either as a comment to an existing post, or as a new topic for discussion, you must login first to the 'Tutoring platform', explained in section 5.6.

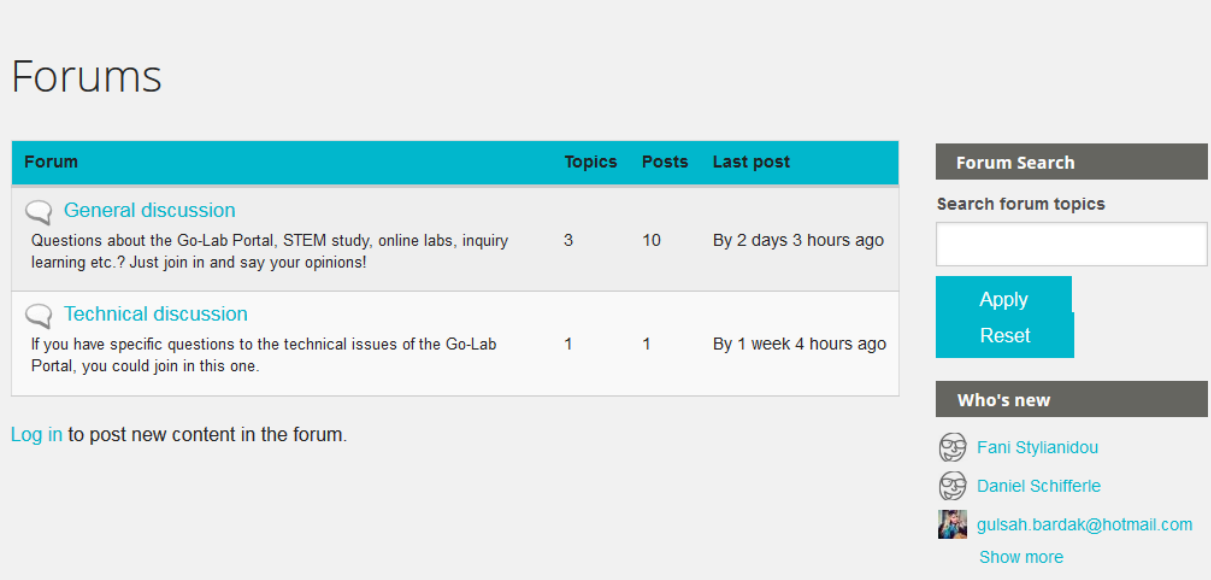


Figure 54: Go-Lab Community forum

5.5 Online course

The “Online course” links opens up a new tab, which contains the Go-Lab Massive Open Online Course (MOOC) for teachers. The course (currently under development) will provide an introduction to inquiry-based teaching techniques and explain how they can be integrated in regular classroom activities. Five scenario-oriented course modules will give detailed instructions on how to use particular online labs, how to create Inquiry Learning Spaces supporting your lesson plans, and how to share and use these spaces with your students, in the course of five weeks.

5.6 Tutoring platform

Finally, the “Tutoring platform” link takes you to a new platform (http://tutoring.golabz.eu) (Figure 55), through which you can access a number of Go-Lab experts, who provide help to Go-Lab users and teachers by offering webinar sessions on a number of relevant topics.

You can search for a particular expert/tutor or sort them according to:

- the rate they have received by other users;
- alphabetically; or
- whether they have recently updated their profile.

Searching for a topic you would like to talk or find out about on this page, also gives you a list with the names of the tutors who have expertise on the particular topic, based on the self-descriptions they have included in their profile.

A list of recently recorded webinar sessions appear on the right of the page. By clicking on them, you are transferred to Goolge+, via which you can watch the recorded sessions. However, if you wish to see what any of the tutors has on offer, request a session, leave a comment, and/or register to attend any future webinar you need to have an account and login in the Tutoring platform. You open an account by clicking on the button “Login/Register” on the top right of the page and complete the relevant information (Figure 56).

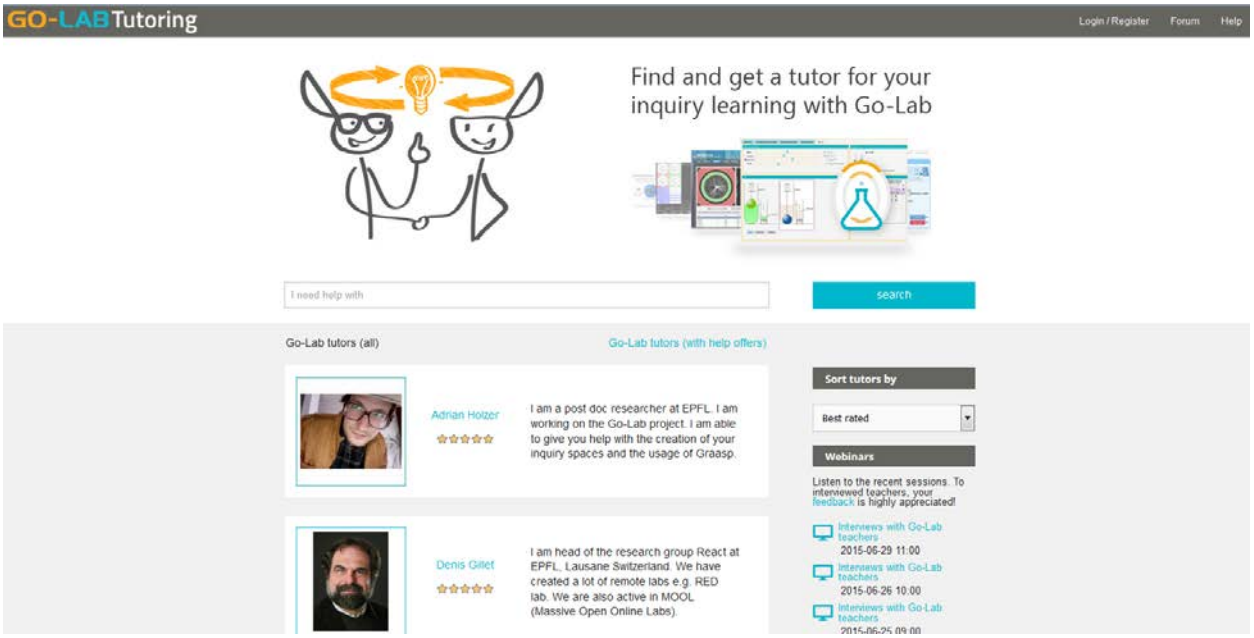


Figure 55: Go-Lab Tutoring Platform

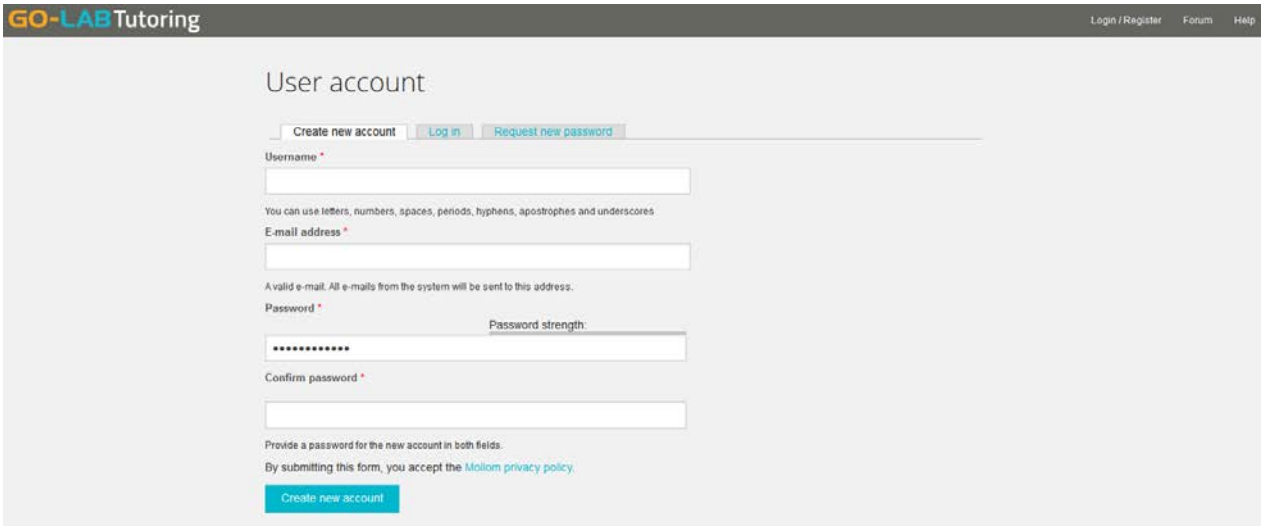


Figure 56: Creating an account in the Go-Lab Tutoring Platform

The Go-Lab Community Forum described in section 5.4 can also be accessed via the Go-Lab Tutoring Platform, by clicking on the button “Forum” on the top right of its pages.

6 Glossary

GoLabz: The Go-Lab repository. It includes a selection of online labs, a pool of ILSs which use the online labs and a collection of apps apt for use in the Go-Lab ILSs.

Graasp: The authoring environment of Go-Lab.

Inquiry Learning Space (ILS): Inquiry-based activities that are structured using the Go-Lab Inquiry Cycle and can contain labs, learning resources and applications to enable and support inquiry learning.

Inquiry Space: A Graasp space which follows the Go-Lab inquiry cycle. It contains one space for each Inquiry phase, an “About” space and a ”Vault” space.

Space (or Graasp space): In Graasp, a space encapsulates the context of collaboration. A space in Graasp can be loosely compared to a folder with associated membership and permissions. In contrast to a folder, a space in Graasp allows not only to store files but also to display dynamic content and run web apps.

Supportive Applications (Apps): Small web based software applications supporting specific learning or teaching goals and tasks in online labs.

Tutoring Platform: The Go-Lab support and communication platform, offering access to peers, communities and scientists to facilitate the use of the Go-Lab learning environment and uptake of inquiry learning activities in the classroom

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