

GO-GA Teacher Implementation Manual

Offline and online ILS use



GO-LAB
**Goes
Africa**



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Reading guide

ILSs can be used **online**, but specially developed ILSs can also be used **offline**. Plan, before you develop an ILS, for what you want to use it: for online with all functionalities, or for offline with a limited number of labs and apps.

Chapter 1 starts with a section on **online ILS** use, this is followed by a section devoted to **offline ILS** use. In the chapters 2, 3, 4 issues for **offline** usage are specifically indicated.

A complete manual or **offline** use can be found in Annex 3.

Chapter 1. Implementation of an ILS in your class

Class implementation of an ILS is concisely described in a bulleted list.

Chapter 2. “How to” implementation issues

Practical aspects related to a final ILS check, appraisal of the ILS, technical aspects, and suggestions when you only have one computer.

Chapter 3. Day-to-day support during the pilot period

In this chapter ways to solicit for support during the pilots is addressed.

Chapter 4. Evaluation and Monitoring of the pilot

In order to better understand ILS use in classes the pilot will be monitored and evaluated. How this is done, the people involved and the instruments used can be found here.

Chapter 5. Go-Lab

This chapter provides you with theoretical background of Inquiry Based Learning, of the purpose of doing practical work in the natural sciences, and of the why of using digital labs and especially why the Go-Lab environment.

Chapter 6. Pedagogical aspects

In this chapter you find suggestions for ILS preparation, and on how to support the learners.

Annex 1. Checklist for an exemplary ILS

Annex 2. Go-Lab in relation to the 5E instructional model

Annex 3. **Offline** manual: instructions to develop and use offline Inquiry Learning Spaces.

Chapter 1. Implementation of an ILS in your class

Online ILS use

This first section deals with online ILS class use. When you have an internet connection at school this is the best option. However, when the school has no internet connection it is possible to use an ILS offline. This will be described in the next section.

Class implementation of an ILS requires that the teacher takes a number of steps. The following bulleted list therefore contains attention points for the teacher to organize your ILS class use.

Before class

1. You developed or selected an ILS for class use. Did you have the ILS you want to use in class checked/evaluated? If not have this done, see chapter 2 under “Final check of the ILS and have it evaluated”.
2. Decide what devices your students are going to use. Make sure these are connected to the internet. Check whether the software on each device is up to date. Make sure that the classroom you want to use is available during the specific period.

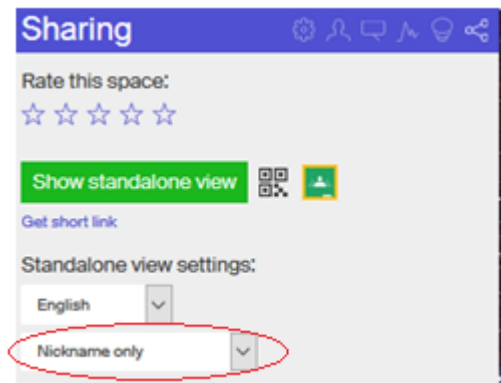
When you only have one computer see chapter 2 under “Only one computer available” for suggestions.

3. Grouping students. How many students do you want to work on one device (preferable not more than 3)? How many groups do you need to make? Compose the groups (names of the students for the particular groups).
4. Do you know how to organize student cooperation?

In chapter 6 under “organize student collaboration” you can find suggestions on how to organize student collaboration.

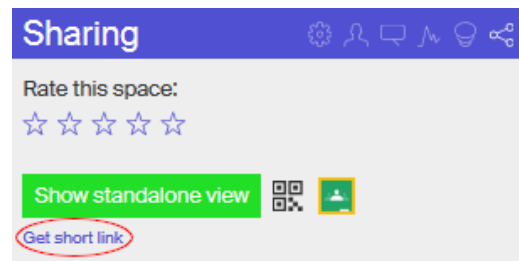
In class

- There are three options for students to log in: with their (nick)name only, with their (nick)name and a password, or anonymous. What you choose for your students in GRAASP is up to you. However when you afterwards want to check what students have done (their answers and how far they managed to get) you need to know the names. This is why “(nick)name only” is default.



- Give students the short link for the ILS you want them to use. You can get the link from the “Sharing” section in GRAASP (on the top right hand side).

This link starts with <http://graasp.eu/s/.....>



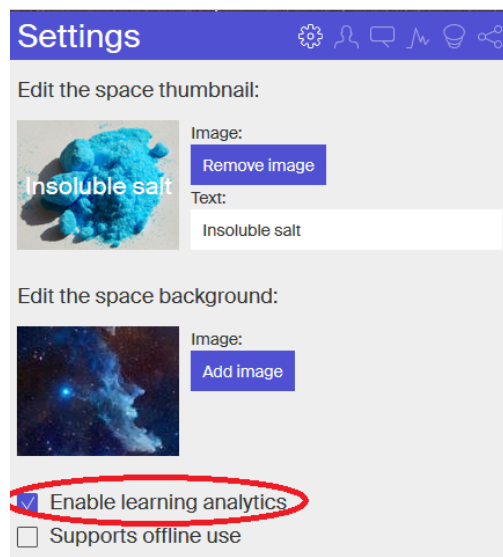
- Students type this link in the address bar of the browser and hit the ‘enter’ key
- Students now have to log in. The system records what students do and in case of a technical failure they can continue working where they ended provided they log in with the same name as the first time.
- Once all students are logged in you should walk around in class to monitor and assist the students. When a number of students have a similar question it is advisable to stop the students from working on the ILS and to explain the issue in a plenary class. This explanation can be subject content when students do not master the prerequisite knowledge. It might however also be related to the process for example when students don’t know what to do next, or it can be a technical issue.

The descriptions under 10 and 11 require you to have Learning Analytics enabled.

In GRAASP you can enable Learning Analytics in the “Settings” area, just tick the box. In the image on the right Learning Analytics has been enabled.

More information about Learning Analytics can be found at the Go-Lab website: <https://support.golabz.eu/learning-analytics>.

Learning Analytics is compliant with the EU General Data Protection Regulation (GDPR).



10. When you included the “online users visualization” app in the Teacher Dashboard in GRAASP you can see in which ILS phase the students are working by opening this app on your computer.
11. When you also included the “activity plot” app in the Teacher Dashboard you can see the relative time each student spent in each of the phases. This time is recorded, so you can also see this after class.

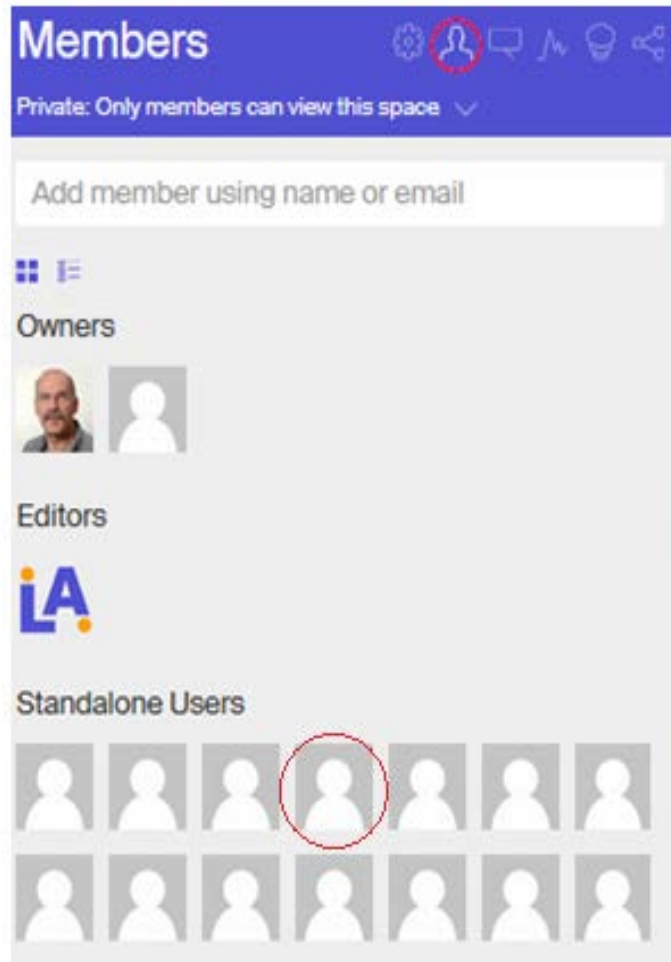
More Learning Analytics apps are available. See the Go-Lab website <https://www.golabz.eu/apps>. On the right hand side under “Categories” you get a list of the available Learning Analytics Apps.

After class

12. After class, when students have finished, you can check what each student has done. For example, their hypotheses, recorded data, other input given, is all stored, and you can read these.

Go to the “Members” section in GRAASP (top right-hand side section).

Here you see the owner(s) of the ILS and each of the figures at the bottom represents a student (or a student group when they logged in under one name). When you click on a figure, the ILS of that particular student will open and all input the student has provided is shown in the ILS. The name the student has used to log in appears on the top right-hand side of the screen.



Offline ILS use

This section deals with **offline** ILS use. Use this when there is no or a very slow internet connection at school.

Class implementation of an ILS requires you to take a number of steps. The following bulleted list therefore contains attention points for the teacher to organize **offline ILS class use**.

For offline ILS use you need to **download and install the GRAASP desktop viewer first**. In this viewer you can subsequently import the offline ready ILS. In Annex 3 you find instructions to **develop** and **use** offline ILSs.

Before class

13. You developed an **ILS for offline** class use. Did you have the ILS you want to use in class checked/evaluated? If not have this done, see chapter 2 under “Final check of the ILS and have it evaluated”. Be aware that in order to make changes to the ILS you need an internet connection.
14. Decide what devices your students are going to use. Check whether the software on each device is up to date. Make sure that the classroom you want to use is available during the specific period.

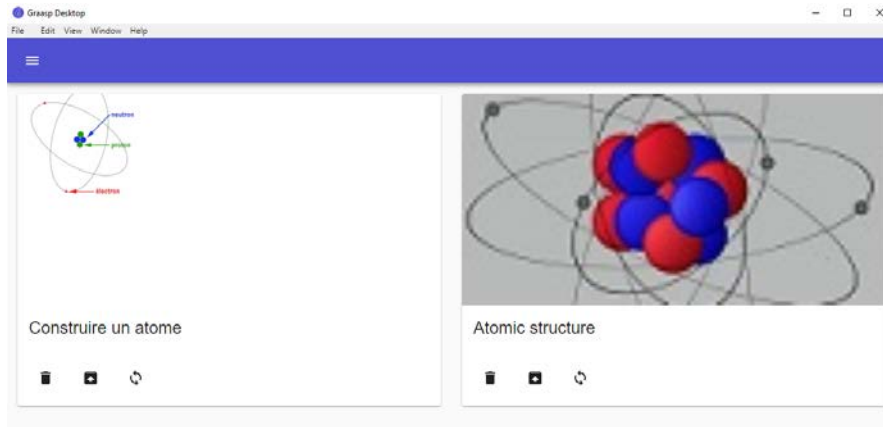
When you only have one computer see chapter 2 under “Only one computer available” for suggestions.

15. Grouping students. How many students do you want to work on one device (preferable not more than 3)? How many groups do you need to make? Compose the groups (names of the students for the particular groups).
16. Do you know how to organize student cooperation?

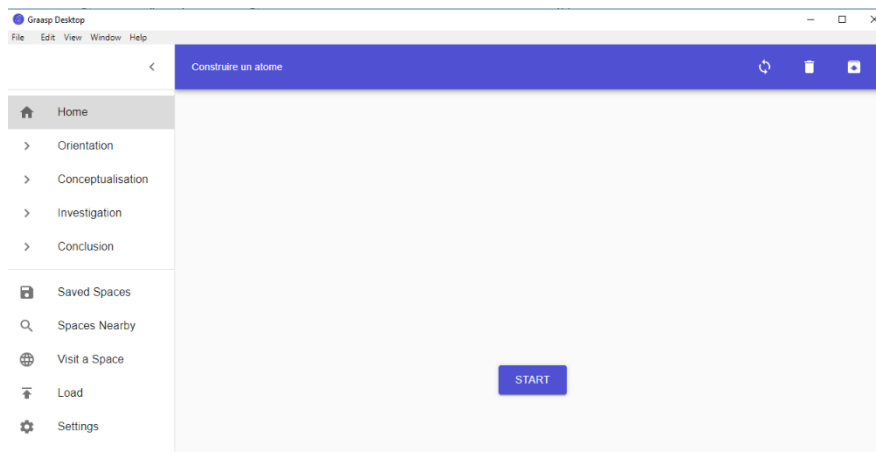
In chapter 6 under “organize student collaboration” you can find suggestions on how to organize student collaboration.

In class

17. You have installed the GRAASP desktop viewer on each of the computers the students are going to use, and loaded the ILS to each GRAASP desktop viewer. (see for the manual Annex 3)
18. Students open the GRAASP desktop viewer and select in “Saved spaces” the ILS they want to use. In the picture below two saved spaces are visible.



Click on the one to use and it will open the following way:



Students can click on “Start”, or on the first ILS phase, in the example above on “Orientation”.

All apps and labs that require an internet connection will **not** work offline!

After class

19. Student input data, for example their answers in the input box, are stored on the computer that was used, and can be seen here. Be aware of the fact that all data are erased when the ILS is synchronised with the online version or when the ILS is deleted.

See annex 3, section “Use the ILS in the GRAASP desktop viewer” number 16 for more information on erasing student input data.

Chapter 2. "How to" implementation issues

Final check of the ILS and have it evaluated

Check your ILS:

1. Does the ILS have at least one lab?

2. Does the ILS have a number of apps to support student learning?
When working in GRAASP



with the basic scenario (orientation, conceptualization, investigation, conclusion, discussion), you can get suggestions for apps for the phase you are in under the "Related" button on the right-hand side panel.

For **offline** use a limited number of apps and labs is available, these are indicated with the offline icon (see also Annex 3).



Apps without this icon cannot be used offline!

3. Is there a conclusion or a final activity for students, and does this relate to the introduction?

4. Is the instruction for students clear throughout the entire ILS to work independently from the teacher?

This means:

- Students should understand the instruction
- Students should know what to do when they read the instruction
- Students should have the knowledge and skills to do this
- When students have finished an activity it is clear what they need to do next.

5. Are there regular opportunities for students to check their understanding?

- Through a quiz in the ILS (with answers or solutions)
- Through the teacher in or after class (**online** use: in the ILS it is also possible to determine what students have answered, see chapter 1, bullet 12; **offline** use: student input data have been stored on the computer in the ILS; open the desktop viewer and the ILS and the answers can be seen)
- Through collaboration with peers?

Mail us so we can give advice and appraise your ILS, or have the ILS published.

You may mail to:

Fer Coenders

fer.coenders@utwente.nl

Ton de Jong

a.j.m.dejong@utwente.nl

or contact your local partner.

Technical aspects

Make the ILS available to the students by using a short link (from GRAASP) or the QR code (see chapter 1, bullet 6).

When you work **offline**, you just let students open the GRAASP desktop viewer and select the ILS in the 'Saved spaces' tab. Students then click "Start".

Only **one** computer available (both for **online** and **offline**)

When **only one computer** (desktop or laptop) is available, different scenarios can be used depending on the availability of a projector or large screen and teachers' preferences.

With a projector or large screen:

Plenary class use: the ILS is projected and each activity is shown and discussed using an educational class conversation.

The 'think, pair, share' strategy can also effectively be used: have each student first write down the answer to an activity personally, and then share these answers with group members and finally discuss this in a plenary class. Once the answer is agreed upon, the teacher or a student types the result in the ILS and can proceed. See also chapter 6, "organise student collaboration".

No projector or large screen present:

Class differentiation is necessary.

Student groups use the laptop or desktop in turns to do the ILS. When the group has completed the ILS, another group will follow working on the ILS until all groups are done.

The students not busy with the ILS are working on other assignments.

Chapter 3. Day-to-day support during the pilot

Mail

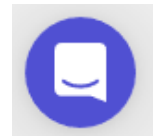
E-mail your local partner or Fer Coenders (fer.coenders@utwente.nl) or Ton de Jong (a.j.m.dejong@utwente.nl) when you have a specific question. We will answer the question within 24 hours.

WhatsApp

There is a WhatsApp support group for your country. All implementing teachers and support staff are part of this group. You can post your queries or advice here, certainly when your communication can be of value to more teachers.

Help desk: on-line chat. Only **online**.

This is already available at GoLabz.eu and in GRAASP. Click on the icon show on the right and a window will open where you can enter in a chat with a knowledgeable member of the Go-Lab community.



Support website. Only **online**.

See the support area at Go-Lab (<https://support.golabz.eu/>).
At <https://support.golabz.eu/compile-your-manual> you can compile your own manual!

Chapter 4. Evaluation and monitoring of the pilot

In order to better assist teachers during their class implementation of an ILS in future, we need to know what issues emerge and how these can be tackled. We therefore hope that you are willing to fill in an evaluation form after implementation. We would also like to solicit feedback from your students through an evaluation form.

What happens in class

It would be great when during class use of the ILS by your students you could:

- take photos or make video recordings. Images show a different kind of information than words.
- jot down all impressions you gain, from the beginning of class till the end. Write down how far students have finalized the ILS in class.

Evaluation

In order to improve class implementation we need to know your experiences. This evaluation will solicit for feedback necessary to improve the teacher training (boot camp), the Teacher Implementation Manual and the support that was in place during implementation.

As your school most likely does not have an internet connection, we will do this evaluation through a paper and pencil questionnaire. One questionnaire for you as the teacher, and one for your students.

The evaluation questionnaires will encompass five categories of questions:

1. ILS class use: what happens in class, for example:
 - How many students worked on one computer/laptop?
 - How long did the students need to finish the ILS-lesson?
2. Teacher satisfaction and teacher preparation, for example:
 - Are you satisfied about the ILS-lesson?
 - Did you meet any problems when teaching this ILS-lesson?
3. Student satisfaction and student learning, for example:
 - Did you like working on the digital environment?
 - Did you have sufficient subject knowledge to work on this digital environment?
4. Pedagogical issues, for example:
 - Where the students able to collaborate in a group? (for teachers)
 - How was the cooperation in your group? (for students)
5. Technical issues, for example:
 - How many devices (computer, laptops) could you use?
 - Have you experienced any technical problem?

Data handling

All participants participate on a voluntary basis and are free to withdraw at any time.

All collected data will be used anonymous. We will only ask the pilot teachers for their e-mail addresses. The pilot teachers will invite their students, their colleagues and the head-teacher to fill in the evaluation form.

Student names or e-mail addresses will not be asked or collected.

Our evaluation research has been approved by the Ethics Committee from the Faculty of Behavioural, Management and Social sciences (BMS) at the University of Twente (the Netherlands).

Chapter 5. Go-Lab

Inquiry Based Learning

Educational research has repeatedly shown that students' knowledge in STEM (Science, Technology, Engineering and Mathematics) remains relatively superficial and does not reach a deep conceptual level. Deep conceptual learning requires instructional methods in which students go beyond the information in the textbook or the blackboard and in which they are prompted and supported to modify (extend, elaborate, classify etc.) the offered content or reflect upon the content, alone or in collaboration with fellow students. Inquiry learning in which students learn from performing investigations is such a form of learning.

Inquiry based learning is an active, learner-centred, pedagogy that requires students to “act as a scientist” and apply various processes of inquiry in order to explore scientific phenomena. Such processes are: formulate scientific questions and hypothesis, perform experiments, observe, collect and interpret data, construct explanations, communicate the results and reflect on process and outcome. When learners engage in this process of inquiry, science becomes alive and students make stronger connections and develop a deeper understanding of the theory and science behind the experiment. Opportunities for interaction with peers can support understanding. Sufficient time for reflection is essential.

Different strategies for inquiry-based learning exist. On the one hand open inquiry, in which all decisions from stating the research question to designing and executing an experiment are fully in the hands of the student. On the other hand structured inquiry, in which the whole process is determined by the teacher (like in a recipe). Guided inquiry is situated between these two extremes. Here various aspects of the process are scaffolded, still leaving enough freedom to the students to learn in a self-directed way. Research shows that neither open inquiry is effective in terms of student learning, especially when students have little experience with inquiry processes, nor structured inquiry, as students might just follow the teacher without real engagement or reflection. Guided inquiry in which guidance and support during the inquiry process is provided, is therefore a promising road towards obtaining good learning results. Go-Lab, as explained later, is an online ecosystem that helps teachers to design and implement guided inquiry for STEM topics. In Go-Lab, a digital lab and apps to scaffold student learning are at the heart of the learning environment.

See for more information the video at <https://support.golabz.eu/go-lab-inquiry-based-science-education> .

Practical work

Performing experiments is at the heart of inquiry learning and also a central aspect of practical work. Practical work is an essential part of the teaching and learning of the natural sciences. Teaching and learning science means bringing students in situations where they can be actively engaged in manipulating variables in order to find patterns and laws to understand concepts in science. The fundamental purpose of doing practical work is to assist students to make connections between the domain of the visible world around them (the observable physical world) and the domain of ideas, models and theories. When classifying practical activities, three main learning objectives emerge. A practical activity:

1. helps students to develop their knowledge and understanding of scientific ideas, models, and theories;
2. helps students to develop their understanding of and gain the skills to use specific scientific equipment, glassware and tools;
3. helps develop students' understanding and skills in using the scientific inquiry approach.

Students often like doing practical activities, it can be motivating and appealing and this will contribute to better learning. Practical activities can be done in a science lab, using apparatus and chemical, but simulations in a digital environment can also be used. It is obvious that in a digital learning environment with a digital lab students can improve their understanding (objective 1 above) and can develop their inquiry skills (objective 3). In a digital environment, students do **not** develop their understanding and skills to use equipment, glass ware and tools (objective 2).

To be effective in terms of learning gains it is imperative that students not just engage in 'hands-on' activities but also use their brains to make connections to previous learned knowledge and to reason about the result of their activities. This means that students need to engage in 'minds-on' activities as well. This is the reason that teachers when doing a demonstration often use the 'predict, observe, explain' (POE) sequence. Teachers refresh students' previous knowledge, then ask students what they think might occur (predict), let students observe the phenomena (observe), and then have students make sense of the observations through an explanation (explain). Each of these steps can be done individually or in groups. This POE sequence shows much similarity to the Go-Lab inquiry cycle, consisting of Orientation, Conceptualisation, Investigation, Conclusion, Discussion. The apps in Go-Lab direct, support, and scaffold student learning.

Why digital and why Go-Lab

Engaging learners in practical activities does not necessarily have to be staged in a laboratory. When students engage in a computer simulation (or online laboratory as it is often called) this can also be seen as doing a practical activity. Through an online lab, students can also develop their knowledge and understanding or learn how to perform a scientific inquiry. Digital labs have some advantages over physical labs: there is no need to buy equipment or chemicals, they therefore do not need to be replaced, there is no (chemical) waste, the preparation time and the cleaning up time are short, the experiment can be easily repeated, and students can do this activity wherever they want, even at home, as long as they have a computer. Real (or wet) labs as they are called, however, have the advantage that students can practice practical skills, so these kind of labs will continue to have an important place in the curriculum.

We have seen above that effective inquiry based learning means that the learning process needs to be scaffolded and guided. We also saw that practical work should not only provide students with 'hands-on' activities but have them use 'minds-on' activities as well.

Scaffolding, guiding and engaging students in 'minds-on' activities and letting them do a practical activity in the form of a simulated experiment is possible in the Go-Lab environment. In this environment labs can be selected for the practical activity ('hands-on'), the process can be structured using the inquiry cycle and thinking can be stimulated using apps ('minds-on').

The Go-Lab ecosystem offers opportunities to design guided learning environments (called Inquiry Learning Spaces, or ILSs) in which the inquiry process is scaffolded by specific guidance and support. The learning environments in Go-Lab ensure that the students get to understand the different phases of the (Go-Lab) inquiry cycle: orientation (preparing students for inquiry: sketching a context and refreshing prior knowledge), conceptualization (building the theory), investigation (designing and performing experiments), conclusion (combining all data to formulate a conclusion), and discussion (reflecting on process and outcome). Apps to guide and support students' learning processes are available in Go-Lab. An app is a small tool that requires students to engage in a specific activity. Apps can be used in different inquiry phases. When for example students need to refresh prior knowledge in the orientation phase, this can be promoted through the use of apps like the "concept mapper", or the "quiz tool". In order to further guide students in their inquiry process, apps like the "experiment design tool", or the "hypothesis scratchpad" may be used. To help students write a report the teacher may include the "report tool" app. Apps are available for each inquiry phase.

For **offline** use of an ILS a limited number of labs and apps is available (see Annex 3).

Commenting and Rating in Go-Lab

At the Go-Lab website, you can comment on labs, apps or spaces (ILSs) and even rate these on a five point scale.

Other teachers can benefit from your comments and ratings, as one can quickly see how you valued it. The ratings and the comments provide information about the quality and usefulness of a lab, an app, or an ILS.

See also “Improve the quality of your ILS” in the next chapter.

Chapter 6. Pedagogical aspects

Inquiry Learning Space(ILS) preparation is crucial

You most likely earlier created an ILS. Below we therefore only present in a concise way the support available for teachers at the www.golabz.eu website.

Different kinds of teacher support for ILS creation can be found at www.golabz.eu. Below a very brief summary of what you can find at the Go-Lab support pages:

1. Under the heading “How to use Go-Lab” a large number of videos explaining how to create an ILS and how to set up Apps are shown. A teacher support manual, an online course, and information about how to start using GRAASP, the authoring platform, can be found here as well.
2. Under “Pedagogical tips”, information with respect to the inquiry learning cycle, pedagogical scenarios, a scenarios handbook, and big ideas of science can be found.
3. Information regarding the Go-Lab community is provided under “Join the Go-Lab Community”.

A last personal check of your developed ILS:

1. Use the inquiry learning cycle (or the 5E model) to provide students a structured learning environment.
2. Make sure that the ILS has **a lab and sufficient apps** plus text to scaffold and guide student learning.
3. Instruction for students should be **clear**, meaning that students should be able to carry out the ILS without teacher intervention.
4. Ideally, components of an effective lesson should be present. Examples, not necessarily in this order:
 - state the lesson objectives,
 - let students refresh prior knowledge,
 - set the stage and provide a motive for learning,
 - offer guidance in the form of apps or text,
 - let students practice before doing the actual experiment,
 - organise and prepare student collaboration to allow effective exchange and discussion of ideas,
 - prepare a closure and discuss further meaning / motive giving.
5. Reflection on learning outcome and the process mark the end of the ILS.
6. When time permits, use the more comprehensive ‘Checklist for an exemplary ILS’ in Annex 1.

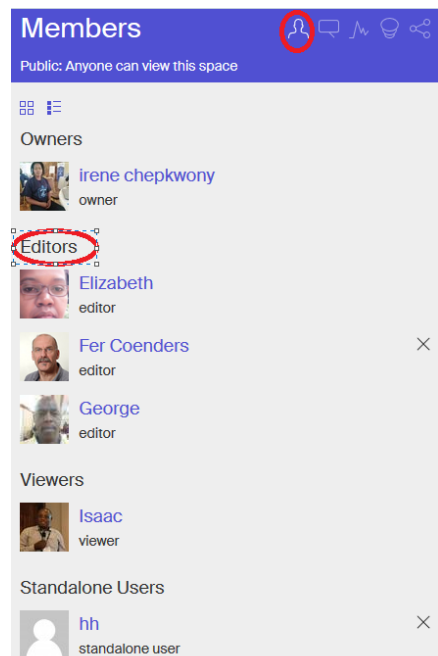
Improving the quality of your ILS

The fastest way to help improve your developed ILS is by asking a “critical friend” to provide comments and suggestions. A “critical friend” is someone willing to help (a friend), and who is also prepared to provide honest feedback (critical). A “critical friend” can be a colleague or other educational professional, who is committed to helping you improve. A critical friend is encouraging and supportive, but also provides honest and often candid feedback that may be uncomfortable or difficult to read. So a critical friend is a professional who agrees to speak truthfully but constructively, about weaknesses, problems, and who provides suggestions for issues.

In our context, a critical friend can be anyone who understands Inquiry Based Learning and is knowledgeable about Go-Lab. It can be a colleague at school, another trained teacher, a staff member from the local partner or from the other project partners.

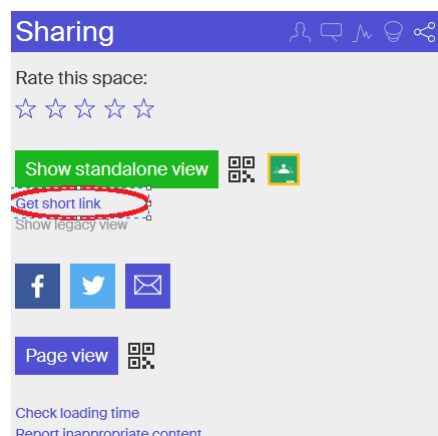
When you have developed an ILS, and are happy with it, take one of the following actions:

- make your “critical friend” **editor** to this ILS in the Members tap in GRAASP. She/he has now access as an editor to the GRAASP environment and can make changes to the ILS.



- e-mail your “critical friend” the short link to the ILS (Sharing tap in GRAASP). She/he is now able to work the ILS as a student and can provide you with comments and suggestions.

When you send us this short link, we are very much willing to provide you with feedback. See also chapter 2, “How to” implementation issues.



Supporting the learners

Most of the support for the students will be built into the ILS beforehand. But also when students are busy working an ILS in class you can still provide guidance and support. Walk around in class to monitor what students are doing, and assist where necessary by asking questions or prompting. Avoid providing answers to questions but guide students through questioning to get to an answer.

Additional instruction

It may be necessary to start with a plenary instruction before letting students work a particular ILS. It is also an option to stop students working when you notice that a lot of students have similar problems they cannot solve themselves. Even when students are busy working an ILS it is possible to provide additional instruction when necessary, for example when you notice in class that students do not have the required prerequisite knowledge to meaningfully perform a specific task. The instruction can be content or process related, and may be provided individually, to a group of students, or to the whole class.

Organise student collaboration

Research shows that collaborative learning, in which students are active, social, engaged, and which is student-owned, leads to deeper learning. Benefits are for example: promotion of higher-order thinking, oral communications, self-esteem, leadership skills, responsibility, appreciating diverse perspectives.

When students collaborate, that is when they share and discuss answers and thoughts, their learning is strengthened. Teachers know that having to explain content helps to personally better understand this content. Effective student collaboration does not happen on its own. Teachers need to design and organise it as part of the learning activity. The following strategies encourage effective collaboration:

- Create learning activities that are complex. This provides students the reason for cooperation. Complex activities require “positive interdependence”: attaining the goal or completing the task require the students to work together and share knowledge. A well designed ILS is in nature complex, and requires students to assist one another.
- Prepare students to be part of a team. Discuss the benefits of collaboration, establish expectations and norms, help students handle conflict disagreement, promote active listening. Ideally this discussion is done the lesson before students engage in an ILS. It might be necessary to repeat it a few times.
- Minimize opportunities for “free riding”. Sometimes, a team member lets others do all the work. One way to minimize this is by assigning team roles to the members, and to have these exchanged each period. A team needs a chairperson and a writer. When the team is larger also a questioner, and a time keeper can be active roles. Have students evaluate their collaboration after the ILS.

- Build in many opportunities for discussion and consensus. Instruct students to agree on an answer to a question before the writer types it.

See for further reading:

Cooperation in the Classroom Revised edition, Paperback, 2008.

David W. Johnson, Roger T. Johnson, Edythe Johnson Holubec.

Student collaboration

Student collaboration, preferably in groups of 2 to 3, is possible throughout an entire ILS or only during specific phases within an ILS.

Throughout an entire ILS:

1. Let 2-3 students work on one laptop or desktop and ask them to discuss and agree on the answers before these are typed in the ILS. Up to three students can effectively work this way, they register under one name. Ask one student to be the chairperson, another to question, and a third one to type the answers. See also the strategies to organise student collaboration above.
2. When the student group exceeds three it will be necessary to assign specific roles to group members: a chairperson is crucial, as is a writer. You can best have the students collaborate according to "think, pair, share". In "think", students write down the answers to the question/activity personally. In "share", students share their solutions in the group, discuss and agree on one answer, which the writer then types into the ILS. The chairperson takes care of an orderly progress of the phases.

In a specific ILS phase:

All apps designed for collaboration require a network connection, so they can only be used **online**.

1. A number of apps are suitable for collaboration in specific ILS phases: Padlet, Shared Wiki, Speak Up, and File drop.
2. Some apps facilitate student feedback, like the Peer Assessment Tool and the Aggregated Concept Map. Before using these apps the first time it is advisable to watch the instruction videos on the Go-Lab support pages.

When the students work **offline**, these apps cannot be used. When you want more insight into student collaboration you may include questions on this in the ILS, for example in the reflection phase (see below).

See for more information the Go-Lab support section of the website:

<https://support.golabz.eu/collaborative-learning>

Reflection on product and process

“We don’t learn from experience. We learn from reflecting on experience.”

John Dewey, 1933

“Reflection is the instrument by which experiences are translated into dynamic knowledge”

Fred Korthagen, 2001

Reflection is the process of looking back at what we have done and linking and construction meaning from experiences. Reflection involves linking a current experience to previous learning, it is an purposeful and active process that deepens understanding.

Reflection leads to better understanding of both knowledge and processes. Students who are inexperienced with reflection might say “this was an easy exercise” or “I liked doing this assignment”. However, this does not tell much about the “why” or “what” of these statements. What made the exercise easy and why was the student able to solve it, and what was learned?

Different ways to engage students in reflection can be used. A simple strategy is the following. Ask students to take their experience in mind and answer:

- What did I (we) do?
- What did this bring me (us) or what did I (we) learn?
- Why did I (we) do this?
- How does this relate to what I (we) already knew?
- What will I (we) do different next time?
- etcetera

It is also possible to reflect on the collaboration process. Similar questions as above can guide this reflection, and additional questions might be:

- Did each team member do what was supposed to?
- What was the result?
- Where the team member roles meaningful?
- Was the collaboration in the team efficient?

Reflection in Go-Lab

Reflection can easily be incorporated in the last phase of an ILS. In “discussion” in the basic scenario, and in “evaluate” in the 5E scenario. Incorporate the relevant questions from above in this phase and ask students to discuss and answer these.

When students are unfamiliar with reflection, it is better to practice it first in plenary class. You could for example use the first 10-15 minutes of the lesson after the ILS class to reflect on students’ experiences, their learning and their collaboration. For this, the strategy “think, pair, share” can be used.

Annex 1. Checklist for an exemplary ILS

An ILS doesn't have to cover the whole Inquiry circle. It can be focused on certain elements of the circle.	
Use at least one lab activity.	
Grabbing attention is important because it motivates learners. Once learners are interested in a topic, they are willing to invest their time, pay attention, and find out more.	
Use surprise or uncertainty to gain interest or introduce incongruity and conflict.	
Stimulate curiosity by posing challenging questions or problems to be solved.	
Stimulate curiosity by using multimedia (video, visuals) to introduce a new topic and review what connections it has to previous learning.	
Keeping the attention throughout the ILS.	
Regularly pose questions or present problems to solve.	
Throughout the ILS introduce new lines of thought.	
Regularly check for student understanding. For example, the ILS could include quiz questions that give automatic feedback or a teacher could use intermediate classroom discussions to check for misconceptions.	
Even if curiosity is aroused, motivation is lost if the content has no perceived value to the learner. Make learning relevant by connecting the content of the lesson to important goals of the learners, their interests and prior knowledge.	
Activate prior knowledge.	
Show where the new knowledge/skills can be applied.	
Relate the content of the ILS to a context well known to the students.	
Use a conversational style and/or virtual coaches.	

Ensure that learners know the names and characteristics of key concepts.	
Help students establish positive expectations for success.	
Start with simple problems and gradually increase the difficulty level.	
Make sure that students feel that they will be successful.	
Give hints about what to do or worked examples on how to do it. Give clear instructions.	
Give support by adjusting the apps to your students age/knowledge level.	
Anticipate on commonly made errors.	
Give extensive and positive feedback. Provide explanatory feedback instead of corrective feedback. Don't just say that an answer is right or wrong but explain why.	
Provide opportunities to the learner to apply the knowledge/skill just gained.	
Working memory capacity is limited. Don't overload working memory.	
Help students focus on the important elements. Use signalling (e.g. bold words, arrows etc.) to attract the attention to certain parts of a text or picture.	
Give meaningful titles to the inquiry phases.	
Videos shouldn't be too long. Maximum 6 minutes, preferably 3 minutes or shorter.	
Demonstrate the use of a lab or guide students to get familiar with it.	
Include both words and pictures.	
Place elements that belong together conceptually together in space or time - Place words near corresponding graphics.	

Do not use irrelevant visual or auditory information – eliminate non-essential material.	
Break long segments into smaller segments. E.g. divide a phase in which students have to scroll a lot into two phases.	
Make ILSs that are mainly sequential. Try to avoid students having to unnecessarily go back and forth between phases.	
Offer navigational support. Give hints how students should proceed after completing a task and/or phase.	
Use the “Hints” functionality to give additional support for those who need it and to limit scrolling.	
Make thinking processes explicit.	
Actively processing information/reflection. Reflection is an important part of the learning process. The educational reformer John Dewey said <i>"We do not learn from experience... we learn from reflecting on experience."</i>	
Promote self-explanations and reflection.	
Include checkpoints for discussion on personal level, group level or on the whole class level.	

Annex 2. Go-Lab in relation to the 5E instructional model

The Inquiry learning cycle as described on the Go-Lab environment strongly resembles the 5E instructional model. Below the 5 E's are briefly characterized and possible Go-Lab apps are indicated that can be used in each of these phases.

Some of the apps from the Go-Lab environment can be imported in other apps. E.g. when the hypothesis scratchpad is used in the explore phase the result can be imported in the conclusion tool in the explain phase. Apps that can be imported in others apps are indicated in red below. Some tools are generic and can be used in different phases: *Input Box, Padlet, Quiz, Quest, File Drop, Speak up*.

Engage:

- elicit prior knowledge
- students make connections between past and present learning
- students to become mentally engaged e.g., by providing students with a learning motive
- arouse curiosity

Apps:

- to elicit prior knowledge and make connections:
Concept mapper, Aggregated concept map, Quiz tool, Quest, Input box.

Explore:

In this phase the lab can be positioned.

- students design experiments, predict outcomes
- students actively explore and manipulate

Apps:

- to plan experiments and predict outcomes:
Experiment design tool, Question scratchpad, Hypothesis scratchpad.

Explain:

- students develop explanations for what they have explored, based on evidence
- students verbalize their understanding
- new terms, definitions, explanations can be provided

Apps:

- to record observations and present data *Observation tool, Table tool, Data viewer, Conclusion tool (hypothesis, observation, table, data), Experimental error calculator, Gomodel*

Elaborate:

- students develop deeper and broader understanding through new experiences

Apps:

- to develop a deeper understanding and bringing it all together:
Report tool (concept mapper, hypothesis, question, observation, table, data), Peer assessment tool (concept mapper, hypothesis, question, table), Speak up.

Evaluate:

- students (and/or teachers) assess their understanding

Apps:

- to assess understanding:
Quiz tool, Quest, Peer assessment tool.

PS. When you are in a an ILS in GRAASP and you use the basic scenario (orientation, conceptualization, investigation, conclusion, discussion) you can get suggestions for apps under the 'Related' button on the right hand side panel.



Annex 3. Offline manual: instructions to develop and use **offline** Inquiry Learning Spaces (ILSs)

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In a nutshell

This is what you need to do when you want to use an **offline ILS**:

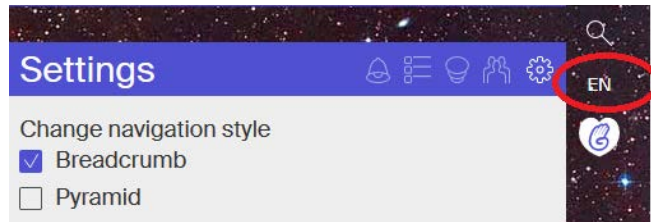
- **Online**: develop online in GRAASP the ILS for offline use.
- **Online**: download and install **online** the program/app that allows you to use the developed ILS offline (the GRAASP desktop viewer).
- **Online**: view and save the offline ready ILS into the GRAASP desktop viewer.
- **Online or offline**: copy the GRAASP desktop viewer and the ILS to a USB device.
- **Offline**: use the USB device to copy the GRAASP desktop viewer and the ILS to the computers for the students to work on.
- **Offline**: Open the GRAASP desktop viewer and the ILS on each computer and use the offline ILS.

Develop online in GRAASP an ILS for offline use

The following steps guide you to develop an ILS for offline use. You need to be **online** for this.

1. Log in on GRAASP
2. Select the language

Click on the “EN” button on the right hand side in the panel. A box will open where you can select the language of your choice. The “EN” will then change to the selected language.



3. Select the lab

Use a **lab** that can be used offline.
In GoLab this is indicated with the icon placed on the bottom right hand side of the lab in the labs repository.



Tip

You can sort the offline ready labs easily by using the sort button. In the 'labs' tab in GoLab you see on the right hand side the sort button. Set this to "Offline-ready first" and hit the sort button.



4. Select the app(s)

Use only those **apps** that can be used offline. In GRAASP these are indicated with the offline icon displayed on the right.

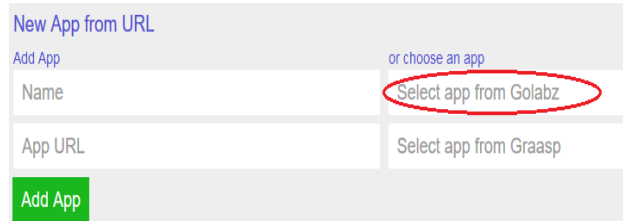
So far only the following six apps are offline ready:

- Input box
- Calculator for offline use
- Quiz tool for offline use
- Hypothesis scratchpad for offline use
- Observation tool for offline use
- Table tool for offline use



Tip

When developing an ILS in GRAASP you can easily select the offline ready apps by using the first window (“Select app from Golabz”)



New App from URL

Add App or choose an app

Name Select app from Golabz

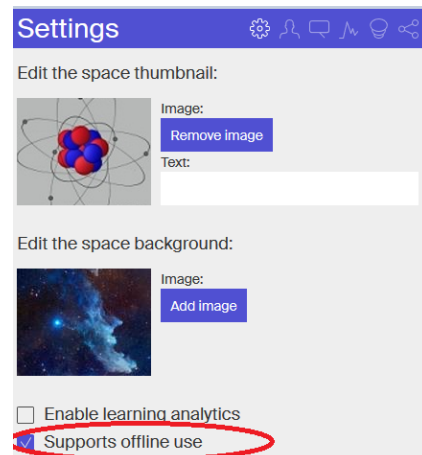
App URL Select app from Graasp

Add App

5. Enable offline use

Online in GRAASP you need to set two specific values:

- Go to “Settings” and tick the box “Supports offline use”.



Settings

Edit the space thumbnail:

Image: Remove image

Text:

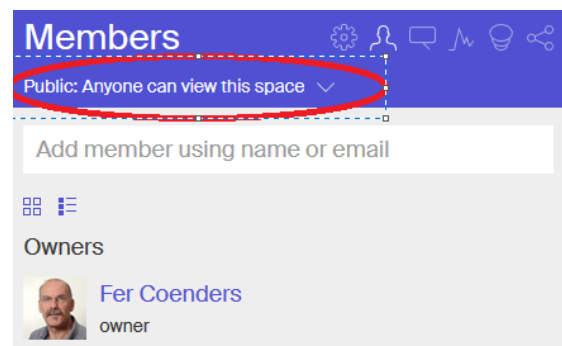
Edit the space background:

Image: Add Image

Enable learning analytics

Supports offline use

- Go to “Members” and set the first line to “Public: Anyone can view this space”.



Members

Public: Anyone can view this space

Add member using name or email

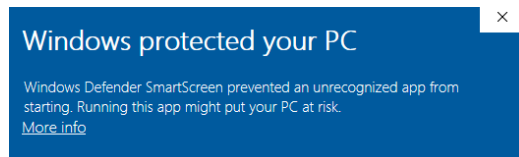
Owners

Fer Coenders
owner

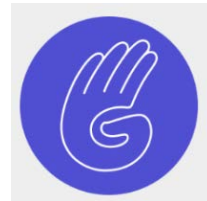
Download and install the GRAASP desktop viewer

Download and install the GRAASP desktop viewer to a computer on the internet

1. Go to GRAASP and do **not log in** (or when you are logged in log out first).
2. Scroll to the bottom of the page where you find the "Try out the new Graasp app (beta) for desktop - [Windows](#) | [Mac](#) | [Linux](#)" line.
3. Select the file for the operating system on your computer and download the file.
4. Install the program.
5. You could receive the following message:



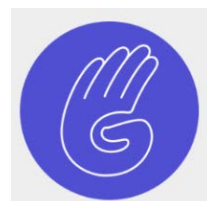
6. Click on "More info".
7. And then on "Run anyway".
8. The GRAASP desktop viewer will be installed and you will see the GRAASP icon appear.



9. Always download and use the latest version of the viewer. The version you are using can be seen under "File" and "About". For example GRAASP 0.15.2.

Download and install the GRAASP desktop viewer to a computer **not** on the internet

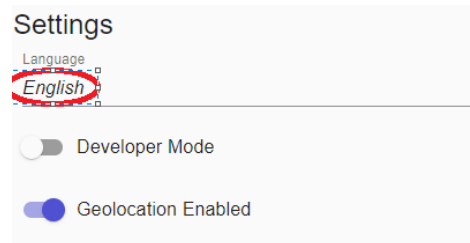
1. Save to GRAASP desktop viewer to a usb device.
When you had downloaded the program it can be found in the 'downloads' folder of your computer.
2. Open this folder and you will see the "graasp-desktop-setup" file. Copy this file to the USB device.
3. Insert the USB device with the program of the GRAASP desktop viewer in the computer.
4. Click on the "graasp-desktop-setup" file.
5. The installation will start. When completed the icon will appear.
6. Repeat the steps 3-5 to install the program on multiple computers.



Use the developed ILS in the GRAASP desktop viewer

Set the language of the desktop viewer

1. Open the GRAASP **desktop viewer**.
2. In Settings set the preference language by clicking on the “*English*” button.

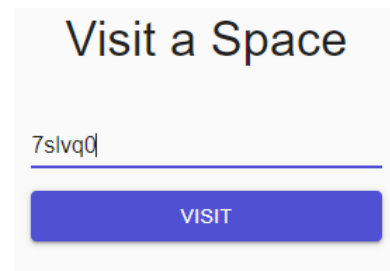


The available languages will appear.

3. Click on the preferred language.
The language of the dashboard on the left hand side has now changed.

View the ILS in the desktop viewer

4. **Connected** to the internet, you can view the ILS in the GRAASP desktop viewer through the “Visit a space” button.
5. Insert in the viewer the last six digits from the short link obtained from GRAASP (online).
6. Then click “visit”.



You can now **preview** this ILS in the desktop viewer.

Save the ILS to the GRAASP desktop viewer

7. Click on the icon on the right hand side of the panel to save the ILS to the computer.



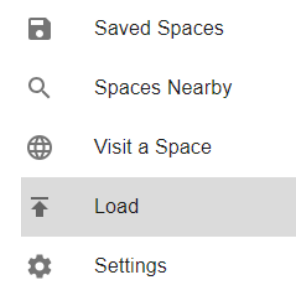
Export the ILS to a USB device

8. Click on the same icon as in 7. The file will be exported to the USB device as a ZIP file. With this USB device you can install the ILS to other (offline or online) computers.



Load the ILS

9. Insert the USB device in the (offline or online) computer.
10. Click on “Load” and a new window will open with a “Browse” button.
11. Click on “Browse” and in the window that opens you can select the USB device and the folder you had the ILS saved to. In the example the ILS called “Atomic structure” was saved on the D-drive (the USB device).
12. Click on “Load” and the ILS will be saved to the viewer on the computer.

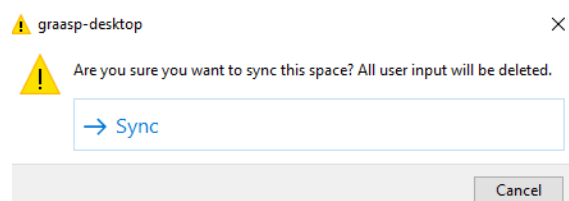


Synchronize

13. When still developing the ILS in GRAASP, **connected** to the internet, and want to use a new ILS version in the GRAASP desktop viewer, use the ‘synchronize’ option in the viewer.
14. Click on the sync icon on the top hand right side of the viewer.



You will now see the following message:



15. Click on “Sync” when you want to synchronize.

Be aware of the fact that all user input, that is all student input that was saved, is deleted after synchronizing.

Deleting input data

16. Click on the icon in red and all data, like text in an Input box, answers to questions in the Quiz tool, student data in a Table, will be erased.



You might want to use this when a student has finished an ILS and another student is going to work on the same machine on this ILS.

(When online, the use of the “Sync” button will also erase all these input data, see “Synchronize” before)

Now you are all set to let your students use the ILS.

All available spaces in the desktop viewer can be seen in the “Saved spaces” folder. Click on the space you want the students to use.

Students can click on “Start” in the “Home” page.

Special feature

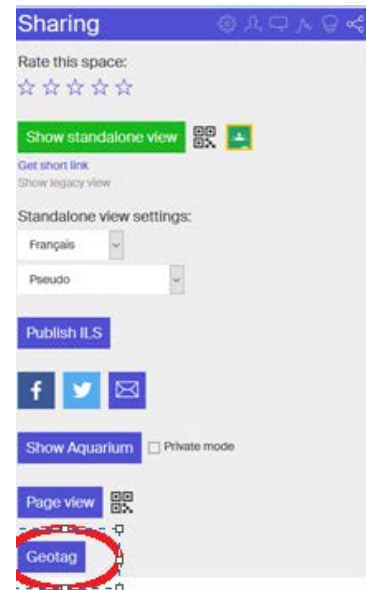
When you have an Internet connection!

The “Spaces nearby” function can only be used when you are **connected** to the internet.

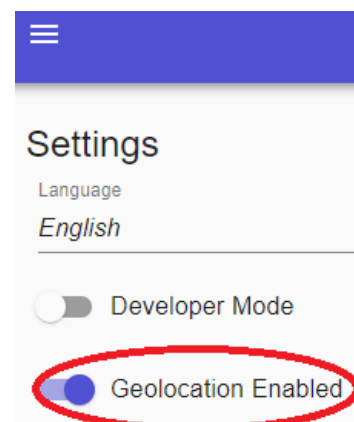
The procedure to enable this is the following:

1. Go to GRAASP online and open the Sharing tab (see the picture).
2. Click on “Geotag”.

You need to give permission to proceed.



3. Enable geolocation in the GRAASP desktop viewer in “Settings”



Now you can see ILSs on computers connected to the internet in a radius of about 50 km.