Next-Lab

Next Generation Stakeholders and Next Level Ecosystem for Collaborative Science Education with Online Labs

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Report on the consolidated implementation and evaluation of the teacher-empowering facilities and activities

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Legal Notices

Executive Summary

The past deliverables and reports of WP2 have mainly focused on its activities to enable and empower the individual teacher – following the title of the work package. Following the suggestions and recommendation of the official review in the summer of 2018 and the corresponding review report, this deliverable serves in addition to address the project's efforts to understand the dynamics and challenges for an uptake of Go-Lab within a whole school, not just one individual, motivated teacher.

To address this new aspect in our work, this deliverable will be structured slightly differently as originally planned. The end of the year reports of WP2 (D2.4 and D2.8) were initially designed to reflect on the user development per country and to analyse how the corresponding national or international activities of WP2 have achieved the user number or ILS creation expectations. Instead, a significant part of the upcoming work and effort will be devoted to present case studies of selected schools to understand why and how these schools were able to integrate Go-Lab more broadly in the everyday teaching of their (STEM) teachers.

The recommendations and comments by the review panel of Next-Lab suggested also to include a more exhaustive summary at the beginning of the document to provide space for more in-depth discussion about the challenges encountered. Therefore, this document firstly summarizes the most important developments of WP2, before it presents the case studies selected per country. Following that, this deliverable outlines the plan to finalise the Go-Lab courses until the end of the project. It further discusses the plans for the pending and upcoming international training events in Cascais, Tallinn, and Marathon, before it provides a short update on the revision of the Go-Lab Support Area, where teachers will be able to find more support material to upgrade their skills on all aspects of the Go-Lab journey.

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1. Empowering Teachers & Empowering Schools – Reflections on the Path Forward

The first section of this report intends to address some of the main aspects mentioned in the review report, especially those concerning the activities and goals of WP2. This section is therefore split into subsections that address those recommendations and discuss the possible consequences for the work of WP2 in the rest of the project's duration.

*Future deliverables should be **more compact** and should try to provide a **critical and reflective view** of the work performed as well as of the **difficulties encountered** and **problems met.***

While it proved difficult to significantly shorten the deliverable compared to the previous ones, this first section includes an extended summary of the overall deliverable, reflecting on the issues at hands, as well as the problems and difficulties encountered. This deliverable is also the start of an additional tasks: looking at case studies in each country that help us better understand the dynamics, the processes, challenges and opportunities that introducing Go-Lab not to individual teachers but to the whole school entail.

The following sections present the path forward and the intended work plan for the remainder of the work in WP2, also keeping in mind how it can be adjusted to correspond to the reviewers' comments.

1.1 Approaching Individual Teachers vs. The School Approach

*The real challenge for the project is related to the capacity of assuring a wide acceptance and adoption of the Go-Lab approach **by a wide number of schools** (and **not** only of single teachers) and decision makers, and **to be really self-sustainable** after the end of the funding period.*

*The focus, from now on, needs to be on increasing the number of people **fully implementing** the system on a **non-sporadic basis**. The aim should be to build on what has already been achieved, thus, it would be valuable to **spread out to the colleagues of early adopters** so as to **strengthen clustered presence in schools**.*

It would be useful to better understand how the project will support the involvement of schools instead of single teachers.

*In addition to this, though a grassroots bottom-up approach is admirable, wider uptake is usually hampered by institutional inertia unless there is buy in at higher levels. Policy level support would be useful, but more important is the **need to address the school ecosystem** and it would integrate Go-Lab. Thus, there needs to be **systemic thinking at the level of whole schools or networks of schools**. This level of impact should be further considered and explored by the project, and indicators related to effective and long-term use in classrooms may need to be developed to support sustainability.*

Teachers remain and always will be the key to the implementation of innovation in school classrooms. It's usually not the ministries or school administrations that are pushing for change, but teachers looking for new tools, answers or approaches that bring innovation into the schools. It usually a bottom up approach.

Changing the approach by shifting the focus away from targeting individual teachers, but to address and target school administration, local and regional authorities, ministries of education, school policy institutes etc., would also mean that Go-Lab would have to become a mandatory tool to be used by teachers. Apart from the fact that in many – if not most –

countries and school systems, the teachers have a significant degree of freedom to choose the media they see best fit their needs, we believe that Go-Lab can only successfully be used in classrooms, if each teacher is convinced that this is the best tool for them and their students. In the majority of countries, however either the Ministry of Education responsible or the school itself (where school autonomy exists) offers teachers with a list of suggested (and approved) tools that they choose from.

Especially, given the complexity of the Go-Lab Ecosystem, a special focus on individual, motivated teachers remains very relevant and needed to provide the necessary support for more teachers to use and integrate Go-Lab into their teaching. The training should be advanced and adjusted to always have in mind that teachers receiving national or international training should ultimately act as multipliers that will themselves train their peers to use and integrate Go-Lab in their teaching.

Nonetheless, the Next-Lab partners acknowledge the need to kick-start a new, additional phase which is very important: to ensure the sustained use of the system beyond the funding period. Clearly, the aspects of sustainability and future exploitation have to become the key focus in the remaining months, and it is clearly an important step to achieve a long-term sustainability and acceptance of Go-Lab. Already, this approach and logic is being applied in the tasks of WP1, where Teacher Training Institutes (TTIs) and policy makers (Ministries of Education) are being involved and targeted.

We do agree and welcome the idea that a larger number of schools is needed as case studies where Go-Lab is introduced at a more structural basis. That requires also to understand what is needed to convince school heads, administrations or local school policy institutes to accept, promote and integrate Go-Lab in their official policies. So in the end, both approaches are not mutually exclusive.

While continuing the efforts to increase the user base, to make the system more known and more widely used, the need to increase and ensure sustainability, meaning an uptake in use beyond the individual teachers is necessary. Consequently, the work and training offered on national and international level will continue as originally planned, however partners will contact and invite specifically teachers from schools where Go-Lab is being used already to extend the user base in their school. Furthermore, the selected case studies (see section 1.2) aim to analyse in greater detail the process of what it means to introduce Go-Lab at school level, its impact to the whole school and the challenges and dynamics within a school in participating countries. This will be done also in coordination with the task 1.4 of WP1, which focusing on assessing the impact of Go-Lab.

One of the first indications from the case studies presented in this document (see section 2) is that in order for Go-Lab to be fully adopted following a more top-down approach, would probably require having pre-made, curriculum specific sets of ILS for each country (or in the case of Germany for each of the 16 different school systems), for each the respective grade level and subject. Only if the material is provided, school headmasters could really push their teachers to take up using Go-Lab. However, the whole project philosophy relies on our experience that the Go-Lab user community creates the ILS based on their specific needs, teaching styles, and ideas. Every teacher has a different teaching style and method, so the idea is to let them create the lessons the way they are planning to implement it.

What is more challenging and most likely too ambitious to achieve in the current project is an extensive monitoring of the students and the impact on their learning. Collecting and analysing students' user data is especially sensitive, requires substantial discussion,

information and permits and is thus problematic. It would require a series of meetings with and permits from school authorities, teachers, parents and/or the students themselves.

One of the most important measures of success of the Go-Lab Ecosystem is how well it addresses its intended user's needs and how effective it engages its end-users in the activities. Both, the Go-lab and Next-Lab projects, have therefore been primarily designed to target teachers (and only in extension schools) and to offer them the opportunity to learn about an innovative and effective methodology to teach science, by engaging them in a various training and community activities. It has always been the project's main hypothesis that Go-Lab can only succeed if the project is able to involve a large community of practice that implements not only the proposed Inquiry Learning Spaces (ILS), but creates new ILSs and motivates and trains their peers and colleagues in the use of the developed materials.

The fact that the user numbers are surpassing the project's expectations already before its end, clearly shows that the initial approach has been working extraordinary well. Over the past six years, the Go-Lab and Next-Lab partners have offered thousands of teachers the opportunity to develop their ICT skills, to take part in real research experiments and to foster the implementation of innovative methodologies in educational settings within and outside of their classroom. Teachers were trained on how to address curriculum content by using the inquiry-based learning methodology, by using online labs, and by motivating students to reproduce scientific discoveries and/or produce their own new experiments. This was only possible, because the projects were focussing on those teachers that have the drive and motivation to upgrade theirs kills, try out new things, understand the need to acquire the needed competences, that are interested in professional development, not because they have to, but because they want to.

1.2 Go-Lab School Case Studies - Understanding the Process and Dynamics of Introducing Go-Lab in a School

*Design and implement showcases based on this **school-wide adoption strategy** for school heads and department heads.*

*Identify a significant **sample of schools (8-12 at different levels)** where **multiple teachers** use Go-Lab ecosystem and **implement a case study approach** to get a 360 degree account of what happens **when** these tool are introduced, not episodically but along a **meaningful period of time** (e.g., at least a full school term of 3-4 months).*

*These should be **rich descriptions** that tell the **whole story** covering a range of aspects such as **pedagogical benefits**, established teaching and learning innovation, co-creation of ILS by teachers, **cost savings**, etc. This would help to illustrate the dynamics of adoption, and also generate stories of co-creation, community, and conversation.*

Co-creation appears to be an aspect that increases uptake substantially and this points to the value of clustering and community building around the use of the Go-Lab ecosystem. Better understanding of the dynamics of use is necessary to corroborate this.

Understanding what it takes for a school as a whole to use and implement Go-Lab would help understand better the strength, weaknesses, opportunities and threads of such an approach. As discussed above, we will approach schools or school authorities **in addition** to targeting the individual teachers.

In the past month, Next-Lab partners have contacted and discussed with numerous teachers and their schools to find appropriate case studies following a set of criteria, where we can monitor and observe the challenges and opportunities that are connected with

introducing the Go-Lab Ecosystem. The identification of the case studies schools is the first step. In the upcoming months of the remaining project, the project team will follow and monitor these schools.

The overall goal is to understand and learn about mechanism of introducing Go-Lab on school level, compare schools that have been doing it for a longer period of time and new schools, recognise the issues and challenges schools are facing, and to have a deeper look and the processes that allow for a more general uptake of Go-Lab. In the end, we intend to compile an overall SWOT analysis that summarises the experiences of these schools. The points that will be taken into consideration will have to be defined, but we'll keep in mind the reviewers suggestions. This will be done in cooperation with Task 1.4 (Assessing the impact), and will include qualitative interviews.

In this deliverable (section 2), the project presents a number of schools, that have been selected based on a set of criteria outlined below. In 2019, the project will follow their activities, discuss with the teachers and school administration about their experience of using Go-Lab, and to understand its impact to the students. These showcases aims to provide us with additional information about how and when teachers are using Go-Lab, if and how they are collaborating on creating ILSs, etc. On the other hand, we also like to understand the obstacles and challenges and why in some cases Go-Lab could not be introduced more broadly.

The case studies present an interesting mix of primary and secondary schools, that have been started to become involved in Go-Lab related activities from as early as 2014 on. Already, the initial collection and short summaries of the schools and their experience with Go-Lab has brought some interesting aspects to further investigate:

- It always **starts with a teacher** that has been introduced to Go-Lab.
  This is not surprising, as the project was especially targeting individual teachers to start using Go-Lab, create ILSs and start implementing it in their classroom.
- In the overwhelming majority of the case studies, at least one **teacher attended an international training event** (e.g. summer school).
  The goal of the international events was the creation of a Go-Lab Community, and to train and encourage teachers to use Go-Lab. Attending an international training event does seems to generate the aimed for multiplication effects. Co-Creation and collaboration among the teachers in a school is a direct link.
- Teachers and school administrations **acknowledge the great potential of Go-Lab**.
  Generally, teachers are quite enthusiastic about the potential of Go-Lab, and in some cases (e.g. France) even the regional school authority has recommended the use of Go-Lab to other schools, based on the reports and feedback received from teachers.
- Working with **Go-Lab encourages teachers to collaborate** with other teachers.
  In many of the case studies, it is mentioned that teachers are sharing their experiences with each other, or try to work on creating common, sometimes even inter-disciplinary ILSs. This is definitely an aspect that should be investigated further, as this could become a very convincing argument to introduce within a school on a broader level.
- School policies give teachers **great freedom in choosing the media** used in the classroom or the learning material to be used.
  In several case it was mentioned, that even thought the school head / STEM department would like to see Go-Lab being used in the classroom, they cannot

make it mandatory for teachers to use it. This is one important challenge to tackle, and this is why the approach to especially convince individual teachers to use Go-Lab should not be abandoned.

- Go-Lab **requires training and practice** to fully establish its potential.
  Go-Lab is a complex system, which does require some effort to be applied and used. Training and ongoing support is crucial and is always the most effective way. However, the revised Golabz support area and the many additional videos are already providing substantial help.
- Schools and teachers prefer **ready-made ILSs that are specifically addressing the country-specific curriculum**.
  Creating an effective ILS does take some time and training. In some of the schools, teachers were asking for a set of produced ILSs for a certain grade or subject that is in line with the curriculum requirements of the respective country. This could certainly be an interesting element in future efforts to convince school heads and ministries of education.

1.3 Creating more effective professional development interventions

The Go-Lab ecosystem is quite complex given the large number of labs, apps, and tools available–each targeting specific content, functionalities and ***activities–learning orchestration and instructional design*** *is crucial, and teachers should be carefully supported.*

Most organized training was 2-3 hours workshops, which appear to be ***too short*** *a period to cover the complexity of the Go-Lab ecosystem. This is an aspect to be considered in the on-going work.*

A consideration that should be taken into account in future work on this task is that ***professional development interventions have proven to be effective*** *if the interventions are* ***long-term and intensive****, and also if they combine* ***learning-off-job with learning-on-job*** *in school. The project approach to teachers' professional development seems mainly based on off-job activities and feedback seems more oriented to their learning than to their teaching (teachers' work in class is not monitored).*

A realistic evaluation of the effort required of a teacher to fully adopt the Go-Lab approach is needed.

The importance of training and ongoing direct and indirect support of teachers has been well described in the past and was greatly acknowledged during the review. In fact, we understand the reviewers' comments in such a way that more formats, but also more effective training formats should be created to appropriately address the challenges faced by the teachers that wish to use and implement Go-Lab. Despite shifting some of the focus to approaching and targeting schools as a whole and school administrations, offering Go-Lab workshops for interested teacher on national and international level is still an integral part of WP2 activities.

It is our experience of the various Go-Lab international training events, that teachers can successfully immerse themselves in most aspects of Go-Lab in about 15-20 hours of training, including sufficient time for practical exercises and testing. However, the typical (national) training is limited to one or a couple of 2-3-hour workshops. In this limited time, teachers are only being introduced to the main concept of IBSE, Graasp and provided only with the first steps. One-day workshops usually cannot go beyond demonstrating how to duplicate or create a basic ILS. In several countries (e.g. Portugal, Spain and Greece) there

are or have been efforts to offer teacher training over a longer period of time with different level of success. The main obstacle was not so much a lack of interest, but a lack of time. Teacher have difficulties committing to attending workshops on weekends, bi-weekly or even once-a-month workshops over a longer period of time, especially if it is in their own spare time, to cover a training duration of at least 25-27 hours (similar to the time of a Go-Lab Summer School).

Teachers' time is very limited. Especially if it requires them to attend these trainings in their spare time. In order to provide successfully longer or more intensive trainings, they need to be organised with the full and official support of the school administration and/or ministries of education. However, professional development activities are being managed quite differently in participating countries. Overall, the time that is officially given to teachers for official professional development is very limited, and usually do not exceeds two days per year. Furthermore, in some countries official on-the job trainings need to be certified by the ministry of education, before they can be used as part of the official in-service teacher professional development programs.

However, there is a clear need to better define the effort required of teachers in order to be considered well trained users of the Go-Lab Ecosystem. Therefore, we aim to summarize the various training workshops and programs in a few Go-Lab courses for each of which we will create a detailed syllabus. The syllabus will define the learning objectives, goals, content of workshops, prerequisites, etc. (see section 3).

In addition, there are great efforts to improve and enhance the support are, where teachers will be able to find specific help and support on mediglacial and technical issues. Many more videos will be included explaining how certain apps and tools are working, how they can be configured and applied best in the overall Go-Lab Inquiry Cycle. (see for the current progress the description of section 5).

1.4 The added value of international training events – a case for sustainability

*The summer schools have the potential to provide opportunities to deepen relationships with multipliers. In this sense they are a valuable asset. The **sustainability** of such events is an issue.*

The international training events and activities have proven to be highly successful and effective activities which has been acknowledged during the first review of Next-Lab. Moreover, the "Go-Lab Teacher Training: Inquiry learning with online labs in schools" has very recently[1] been identified by the European Commission's Innovation Radar as an "Excellent innovation".

For the project, they are an essential investment into the creation of a strong, user-driven and experienced Go-Lab teacher community which has significant multiplying potentials and effects. We have witnessed these effects both in the Go-Lab project as well as in the Next-Lab project. In most of the case studies of section 2 it was a teacher that experienced a Go-Lab summer schools that became a driving factor in the introduction of Go-Lab to the overall school. Therefore, we believe that they are an important step in supporting the uptake of Go-Lab on school level.

[1] https://ec.europa.eu/digital-single-market/en/innovation-radar 6 December 2018

As discussed above, the complexity and richness of the Go-Ecosystem is asking for intensive training. A multipole day training event is logically more effective for having intensive and in-depth discussion and training opportunities, not only for the participating teachers to learn, but also for the whole Next-Lab team. They provide a unique chance to work together closely, so teachers were able to learn profoundly all the main aspects of the Go-Lab system and context, and the project team and developers were able to receive on-the-spot feedback from the users.

Following the Next-Lab project review in June 2018, the consortium decided to shift the focus of the remaining international training events and give more emphasis on the core interrelated issues the project should be focussing on for the remaining months: multiplication and sustainability. Consequently, the topics and target groups for the Winter and Spring school have been adjusted (see section 4). Additionally, the consortium decided to test if the summer schools in Marathon can be driven solely by participants that are using 3rd party funding to attend the course. This will be a test-run to see if activities such as summer schools generate enough interest among teachers and schools that they are willing to undergo the process of writing and submitting Erasmus+ KA1 applications that provides funding to the participants to attend. Using Erasmus funding has also the advantage that it could generate some income to at least partially cover the costs of such a school for the organisers.

2. Empowering schools through the teachers – On overview of Go-Lab Schools

As part of the review feedback received was the recommendation to "*identify a significant **sample of schools (8-12 at different levels)** where **multiple teachers** use the Go-Lab Ecosystem and **implement a case study approach** to get a 360 degree account of what happens **when** these tool are introduced, not episodically but along a **meaningful period of time** (e.g., at least a full school term of 3-4 months)."*

As discussed above (see section 1) this is a fundamental shift in the Go-Lab approach applied over the past years. However, it does offer the chance to better understand the challenges and opportunities that schools as a whole are facing when trying to introduce innovative and new technologies into the classroom.

At this point of the project, each partner has identified at least one school that will serve as a case study throughout the remainder of the project. The team of WP2 set out some basic criteria, and collected an interesting mix of primary and secondary schools, as well as schools or teachers that have joined Go-Lab many years ago, or that have recently started using Go-Lab.

In this deliverable, the overall idea is to have a collection of case studies that consist of examples of schools where Go-Lab has been effectively introduced to the STEM teaching and the school's curriculum – or are about to. Ideally, the schools fulfil the following basic criteria:

- **At least 2 teachers** are using Go-Lab regularly (at least 2 different ILSs in the same classrooms)
- The **school administration is supporting** the introduction of Go-Lab to the science classrooms
- **Teachers have gotten support or training** (offline and online) and/or other forms of support by a NEC / Next-Lab partner

The description of the case study should present the process of how Go-Lab has been introduced / is about to be introduced. It should answer questions such as: How did they learn about Go-Lab? What made them convinced to use it? How did they convince the school administration / the STEM colleagues to use Go-Lab? What the support was given to them? How is the reception among students and teachers? Basically, everything that would support our efforts to "promote" Go-Lab to other schools or Ministries of Education.

To present the information in a similar fashion, the structure of the case studies follows a similar approach:

Short profile of the school

A short description of the school. Is it primary or secondary? Is it in a rural area (= maybe there is a stronger need for online labs)? Does the school have a specific STEM profile / focus? Has Inquiry Based Science Education (IBSE) been applied in the school before?

A brief history of Go-Lab and the school

How did the school learn about Go-Lab? Did all the teachers using Go-Lab learn about it together, or did one teacher introduce it to other(s)? How many of the teachers using Go-Lab in your school received training in an official Go-Lab event? How did other teacher(s) learn how to use the Go-Lab system? What was the reason to use Go-Lab in the first place?

The use of Go-Lab in the school

How many teachers have been using / are currently using Go-Lab in their classes? In what age groups is Go-Lab being used? Is there a "formal decision" by the schools' STEM departments to use Go-Lab? Is the use of Go-Lab mandatory for all teachers? How many times has each teacher used Go-Lab in their classrooms? What subject areas are covered?

Are teachers creating their own ILSs or are they using existing ones? Do they implement the complete Inquiry Cycle, or do they use them partially (some but not all phases)?

The Go-lab Experience - Teachers

How is Go-Lab being appreciated among teachers? Do teachers believe that Go-Lab Is supporting the introduction of IBSE / the scientific method more effectively than other methods? Are teachers collaborating with other teachers (inter- / multi-disciplinarity)?

The Go-lab Experience - Students

What is the general feedback of students working with Go-Lab in this school? Are they enjoying the Go-Lab activities more than other forms of teaching? Do teachers believe that the students acquire a deeper understanding of the subject(s) at hand? Are students changing their way of thinking or their behavior towards science after using Go-Lab?

2.1 G C School of Careers - Cyprus

Short profile of the school

The G C School of Careers is a private urban school in Nicosia. Although it is not a STEM school, they plan to become over the next two years. Inquiry-Based Science Education is applied in the school the last two years, mainly in Grades 7, 8 and 9, after an introduction made by the teacher who has attended a Go-Lab training event.

Specifically, the first introduction was made at the Physics Department, then at the General Science Department and finally at the Chemistry Department. After this dissemination, each Department started to revise their teaching methods, according to the IBSE model.

A brief history of Go-Lab and the school

As mentioned above, the school learnt about Go-Lab and IBSE from the teacher that has been trained in a local event in 2016 and an international event in 2018 (Bilbao Spring School). This teacher (Go-Lab teacher) implemented some ILSs in his classes during the school year 2016-2017 and informed his colleagues and the school administration about the Go-Lab Ecosystem and its potentials, especially for the introduction of inquiry learning into teaching and the use of online lads. The next school year (2017-2018) the Go-Lab teacher collaborated with two other teachers from his Department and together they implemented a co-teaching using one of his ILSs. Apart from this collaboration no one else received a training to use the Go-Lab Ecosystem, thus they have not created and implemented their own ILSs. However, after the co-teaching experience they are very interested to use ILSs into their teaching practice.

The use of Go-Lab in the school

Currently, Go-Lab is used by the Go-Lab teacher, who has created several ILSs and implemented two of them in two of his classes with 9th graders (14-15 years old). The co-teaching mentioned before was made in collaboration with two other teachers, therefore an ILS has been implemented in total six classes of Grade 9. The design of the implemented ILS followed the complete inquiry cycle scenario.

After these experiences, the school and specifically the Physics Department, the Chemistry Department and the General Science Department agreed that Go-Lab must be included into their curriculum, however without being mandatory or time consuming, mainly because the most important aim of the school is to prepare students for the exams.

Additionally, teachers concluded that they prefer to use ready-made ILSs, that will be provided by their Department, instead of creating something on their own. According to the Go-Lab teacher, their main task during the next years is to create a list of ILSs for some of the lessons of their curriculum, which will be readily available for those teachers who wish to apply them. The Go-Lab seems to be very attractive for the needs of the school because it combines the IBSE with the use of technological innovations in education. Therefore, the resources available in the Go-Lab Ecosystem, makes it a particularly useful educational platform which is convenient for the teaching staff of the school. Moreover, over the next two years the school will be fully equipped with tablets for students and teachers and the fact that the Go-Lab Ecosystem is compatible for use in tablets will help even more its implementation.

The Go-Lab Experience – Teachers

The teachers of the school are very enthusiastic with Go-Lab and they are willing to use it if their Department provides them with ready-made ILSs. In general, they believe that Go-Lab is the perfect tool to allow them introduce inquiry learning in their classes and at the same time they consider it as an innovative technological tool to help them make their lessons more attractive for their students. However, they have not received yet a Go-Lab training. Regarding this, the Go-Lab teacher has received support from the NEC (i.e. training materials: power point presentations, hands-on activities, manuals etc.) to organize a training event for his colleagues. The training event is planned before the end of 2019.

The Go-Lab Experience – Students

Most of the students commented that using Go-Lab for their classes is very interesting, mainly because it is something new and very different from what they are doing in their lessons. Many students expressed their willingness to use Go-Lab more often in their classes because it helps them to gain deeper understanding of the topic at hand. However, according to the Go-Lab teacher, it is very early to claim that the use of Go-Lab is changing their way of thinking and their behavior towards science. However, this is something that he personally wants to investigate, after his school will be well organized to use Go-Lab in a systematic way.

2.2 Tartu Hansa Kool - Estonia

Short profile of the school

Tartu Hansa Kool (https://www.hansa.tartu.ee) is a public basic school (i.e., grades 1 to 9) in Tartu, Estonia. The city of Tartu has about 100,000 inhabitants and Tartu Hansa Kool has around 750 students and 65 teachers. Inquiry-based science objectives have been listed as required goals in the Estonian National Curriculum since 2011.

A brief history of Go-Lab and the school

The Go-Lab learning environment was first introduced at Tartu Hansa Kool by Mario Mäeots, who works part-time as a 4th to 6th grade science teacher at the school, in addition to working as full-time academic staff at the University of Tartu. At the university he has been involved with the Go-Lab project since the beginning and was able to first introduce Go-Lab into his teaching practice at Tartu Hansa Kool in 2014. He also attended the Go-Lab Marathon Summer school in 2014 to share his experience with other teachers and learn how others were using Go-Lab.

The use of Go-Lab in the school

Over the years, Mario has encouraged his fellow science teachers at Tartu Hansa Kool to attend in-service professional development courses at the University of Tartu about Inquiry-Based Science Education. These courses usually occur as two full-day sessions. The first session trains teachers about the inquiry-based approach and introduces them to the Go-Lab Ecosystem. Teachers work in a computer classroom to create an inquiry learning space in Graasp by following the directions of the instructor. At the end of the first session the teachers are assigned a homework assignment to create an inquiry learning space for their class and implement it with their students. The second session, which usually occurs about a month later, requires the teachers to make a presentation about their inquiry learning space and the experience they had using it with their students. The instructors and peers in the course provide feedback and comment to each of the presenters. Having the in-service course occur in two sessions separated by a month-long intermission period provides the opportunity for teachers to apply their knowledge of Go-Lab in practice and reflect on their experiences afterwards in a supportive group of other teachers and university instructors.

In 2018, two teachers (Eno and Kädi) from Tartu Hansa Kool attended the Inquiry-Based Science Education in-service professional development course at the University of Tartu. Because of their enthusiasm towards Go-Lab, they were invited to attend international Go-Lab training events. Eno travelled to the Bilbao Spring School to work on co-creating ILSs together with researchers from the University of Tartu. Eno is a science teacher and helped create ILSs dealing with the topics of biology and healthy eating. Kädi travelled to the Marathon Summer School to learn more about creating ILSs.

Interestingly, Kädi is not a science subject specific teacher but a general primary school teacher for 2nd and 4th graders. Nevertheless, she realized the potential the Go-Lab has a domain-independent learning platform and on her own initiative organized a one-hour introductory workshop to her colleagues of how to create and use Go-Lab learning spaces.

After she told us that her colleagues were impressed with the possibilities Go-Lab offered, we offered to come to the school and provide follow-up training with Go-Lab. Kädi organized the time, booked the computer classroom and wrote to her schools mailing list to invite all teachers to this event. Since many teachers in Kädi's introductory workshop were not science teachers, we decided to alter our traditional training approach to take a more discipline independent view of Go-Lab. This meant that we treated Go-Lab as a web-based learning environment where teachers can easily create digital lessons to include a variety of multimedia content and quickly share these lessons with their students. Furthermore, we wanted to demonstrate to the teachers how easy it is for them to share learning spaces among themselves and how they can co-create learning materials together.

The on-site training provided to Tartu Hansa Kool occurred on November 15th, 2018 and 13 teachers participated (12 female, 1 male). Many teachers taught more than one grade and all grades between 1st and 9th were represented: 1st grade (1), 2nd grade (4), 3rd grade (4), 4th grade (3), 5th grade (3), 6th grade (3), 7th grade (4), 8th grade (3) and 9th grade (3). The subjects the teachers taught included general primary school topics (5), Estonian language (2), mathematics (2), science (2), arts & crafts (2), English language (1), career advice (1), physical education (1) and computers (1). One teacher did not teach particular subjects, but reported being in-charge of children's after school extra-curricular activities. This range of teachers at Tartu Hansa Kool who chose to attend the Go-Lab training event demonstrates that the Go-Lab learning environment is appealing to teachers not directly involved in inquiry-based science instruction. Overall, the training event led by the University of Tartu researchers seemed to further increase the confidence of the participating teachers to apply or continue applying Go-Lab in their instruction.

The Go-lab Experience - Teachers

At present, it appears that teachers at Tartu Hansa Kool are creating their own ILSs rather than using existing ones found on GoLabz. This may be due to the limited selection of ILSs in Estonian that match the topics the teachers want to teach. A positive feature of Go-Lab use at the school is that many teachers share the learning spaces among each other and co-create digital lessons together. We would like to follow up with these teachers at a later date to examine what effect Go-Lab has had on their students.

2.3 Two case studies - Finland

Short profile of the schools

At the moment we aim to have two different schools with rather different profiles in order to try out different approaches and different roles for Go-Lab within the teaching in school.

The school A[2] provides primary and secondary education for 900 students in total. The comprehensive (primary) school includes the grades from 1 to 9 (ages 7 to 15), and the secondary school continues three years after that (for students aged 16 to 19). The school is multicultural and international, and it offers a specialized program in science for one class in every age group. Two years ago, the school was renovated to support more collaborative learning and usage of ICT in education, and it is now eager to implement innovative pedagogics using technology.

[2] At the draft of the deliverable, the written consent of the schools to have their name published has not been received.

The school B provides comprehensive (primary) education for the grades 7 to 9 (ages 13 to 15). It is also located in the city of Turku but differing from the school A in a sense that it is operating under the city governance. The school is profiled in special education, and this is realized in smaller student groups and more flexible curriculum compared to the usual schools. The school has already implemented inquiry learning in their curriculum, but the usage of ICT (in inquiry learning) is still low.

A brief history of Go-Lab and the school

The school A learnt about Go-Lab in an EduDevelop seminar organized by the Department of Education, University of Turku. Our team had a poster session and iPads showing demos of Go-Lab ILSs there, and among other participants, three teachers from the school A were introduced to Go-Lab approach and platform. During the introduction, we appointed a date and time to come to the school and organize a lesson in a real classroom situation for 4th grade students. After the successful lesson, we agreed about the later collaboration with the school. The school's interest in implementing Go-Lab grows from the versatile usage potential of the platform. First, it offers virtual laboratories and an approach that can be used in different topics and for many age groups. Second, Go-Lab offers materials in different languages, which provides opportunities to give lessons in students' "own language". Third, the school supports the teaching personnel to do research in their classes, and virtual inquiry learning could be an interesting theme also for these research purposes.

The collaboration with school B started after a dissemination post to a Facebook group for teacher students and teachers. A teacher from the school contacted our team, and invited us to their school to give a Go-Lab lesson for one of their 8th grade classes. The student-centered approach and examples of different inquiry learning materials convinced them to immediately start experiments also in another class. Now we have arranged two days in early January to visit in the school and provide lessons and training for the teachers there.

The use of Go-Lab in the school

In the school A, Go-Lab will be introduced for all the teachers on grades 1 to 6 (age groups 7 to 12). The implementation of Go-Lab is supported by the school heads, but since the teachers are enjoying a strong autonomy, the classroom usage cannot be mandatory. At this point, one teacher has used Go-Lab in her classroom (complete Inquiry Cycle material) and based on the good experiences we are expecting a vast implementation during the year 2019. To support this, we are providing training and workshops for all the teachers in the school. In classrooms, our plan is to use the existing materials and co-create new ILSs based on the needs of the school.

In the school B, two teachers are starting to use Go-Lab in the first phase. They are teaching 8th and 9th grade students who are between ages 14 and 16. After the first phase, we are expecting the other teachers to start implementing Go-Lab too. In order to support this, we are offering trainings and support for the teaching personnel. Nevertheless, since the teachers are having a strong autonomy, the usage cannot be mandatory.

The Go-lab Experience - Teachers

In school A the contact teacher was enthusiastic about the implementation in her classroom and immediately saw possibilities for wider use of Go-Lab in the school. As the person responsible for the science teaching, she also recognized the broader value for the other science teachers in the school and wants to get them all involved and even brought up the idea of utilizing the flexibility of the system for small scale within school research. Under the new curriculum all schools have to organize inter- / multi-disciplinary projects, and as such

collaboration among teachers is increasing. The aim is to have Go-Lab both as an environment around which this collaboration can be shaped, and as an environment within which these collaboration efforts are realized.

In school B there has not been real implementation yet, but from their point of view with a less strict curriculum, they see Go-Lab and ILSs fitting well in their teaching approach. Given the nature of their students both the school and the NEC are interested to see how more self-regulation-oriented learning can be integrated in the education of this special needs children. The nature of the school also makes that there is naturally close collaboration between different teachers.

The Go-lab Experience - Students

The ILS that was used for the implementation in school A included a reflection at the end, and the comments from the students in the reflection clearly indicated that they liked it. The teacher also did an informal evaluation through a few questions that the students answered by putting their thumps up or down, and this also resulted in an almost unanimous positive expression of appreciation, the wish to have this kind of lesson more often, and also that they perceived themselves to be learning. The latter was also confirmed by the examples that the students gave about what they have learned.

2.4 Germaine Tillon - France

Short profile of the school

"Germaine Tillon" primary school is located in the peninsula confluence between Rhône and Saone rivers in the 7th arrondissement of Lyon. The school is very recent and has been built within the large urban planning project to renovate the confluence neighborhood. Right now, the school hosts pupils from mixed social origins due to its position close to both renovated and old untouched areas.

There is no special profile on STEM but the school has a school garden for teaching purposes and is well equipped with computers. No previous focus has been put on Inquiry Based Science Education but one of the teachers had worked with her class and a colleague from IFÉ NEC on astronomy.

A brief history of Go-Lab and the school

Go-Lab was introduced to one of the teachers by our colleague astronomer from IFÉ NEC. She decided to introduce Go-Lab to one of her fellow teachers and succeeded in recruiting her explore together the capabilities of Go-Lab ecosystem. The first reason to explore Go-Lab was curiosity and the will to provide more efficient teaching for all pupils. Both teachers attended the training sessions at IFÉ and accepted to go to the Marathon Summer School in 2018. The decision was a challenge to the teachers, as the average level in English language of French primary school teachers is low. The two teachers were afraid of not being able to understand the training materials and not being able to exchange with other trainees. In fact, Marathon summer school was a great experience that motivated them to advertise Go-Lab to their school administration.

The use of Go-Lab in the school

Two teachers are using Go-Lab for STEM courses for 6-8 years old in 2017 but they move towards the upper level every year to take care of the same group of pupils during all their presence in the school. Go-Lab has been started as an individual action validated by the headmaster. After the Go-Lab Summer School, the teachers forwarded reports to the headmaster, their local coordinator for STEM and the inspector in charge of the area. Their enthusiasm and the quality of the reports led to a meeting where it was decided that their initiative has become an official action of the school. The inspector decided also to set up a strategy with the coordinator to spread the initiative to other schools in the area. In France it is not possible to make a tool mandatory because it challenges teacher's pedagogy freedom but the word of prescribers like the inspector or the coordinator are listened.

Go-Lab is currently being used to teach physics: temperature, heat, buoyancy and to introduce serious games with "Tibibo" library. The first ILS was constructed by the NEC but quickly transformed through co-construction process. The teachers wanted the instructions to be written and jointly available as a sound. Tests were made to see which voice was best accepted by the pupils: their own teacher, another teacher or a foreigner. Finally, teachers have produced their own ILSs tailored to fit their pedagogical targets, sometimes mixed with real experiments substituted to experimentation phase.

The Go-lab Experience - Teachers

The major drawback pointed out by teachers is the time needed to fully immerse to the Go-Lab Ecosystem. But both teachers agree that the return on investment is high for whom accepts to do the necessary efforts to master it. Teachers have enjoyed a lot Go-Lab because they have been able to make real their ideas on the use of digital data in their activity. The use of vocalized instructions has been a great success because the pupils with less reading capabilities where able to do the exercises at the same time as the others thanks to hearing the instructions instead of reading them. The flexibility of the ecosystem is a great advantage that goes beyond the introduction of IBSE which is important for younger pupils who take time to adapt to a digital learning environment.

The Go-lab Experience - Students

The feedback has been very good from the students, they do enjoy he Go-Lab activities and they appreciate a lot to be able to upload their work. They have produced pictures and recordings that are shared in the ILS. As quoted previously the recording of instructions has been a great progress for the weak readers, it enabled them to be synchronized with others and moreover improve their image in the class and for themselves.

For the whole class the experience with learning science is easier and much more pleasant. In France student usually have only one try for each exercise, with Go-Lab the teachers can let them investigate and do multiple tries until they succeed or think they have understood the point.

2.5 2nd Primary School of Voutes - Greece

Short profile of the school

The 2nd Primary School of Voutes is located on the outskirts of the city of Heraklion. It is a relatively large school which has an ICT and physics laboratory and educational robotics equipment. Over the last three years, the school has focused on the development of interdisciplinary, inquiry-based STEM activities using every day materials, 3d printing and

physical computing focused on understanding physics concepts and the development of students' computational thinking.

A brief history of Go-Lab and the school

Go-Lab was introduced to the school by the ICT teacher, Siligardou Fotini who is also a Scientix Ambassador and was trained in the Go-Lab 2016 and 2017 summer schools. She did a presentation for teachers who were interested in using Go-Lab in their classrooms. Currently the team of teachers that uses Go-Lab regularly also include teachers Agathi Michou, Thomais Karamanou and Euthimia Adamantidou. Additionally, an introductory workshop of the Go-Lab project was also carried out for the primary school teachers of Heraklion during a Scientix event in 2017. The reason that Go-Lab was used in the first place is that it is a common belief in our school that the way to implement STEM activities goes through inquiry-based learning.

The use of Go-Lab in the school

Until now Go-Lab has been used by four school teachers, for 5th and 6th grade students in order to support the implementation of our school's projects. These activities draw on the introduction of modern physics and cosmology through the “Playing with Protons” project and space and environmental awareness (“Playing with Protons” is an education initiative led by the CMS experiment at CERN bringing together primary school teachers, science education specialists and CERN researchers to develop creative approaches to helping all primary students engage effectively in physics, discovery and innovation). Teachers are creating their own ILSs, some of them using the complete Inquiry Cycle and others using some phases, depending on the activity. (More information about the activities can be found in http://silfot.wixsite.com/playingwithprotons)

The Go-lab Experience – Teachers

Teachers are thrilled by the effectiveness of using inquiry-based learning to implement multi-disciplinary activities and the increase of student’s interest and motivation. Until now, Go-Lab is being used in the ICT lab in teams of two students and in collaboration with the class and the ICT teacher.

The Go-lab Experience - Students

The use of Go-Lab in combination with hands-on activities has increased student’s motivation and deeper understanding of even difficult concepts of physics. The students actively followed the process of inquiry-based learning. They enjoyed the activities and actively followed all the implementation phases.

2.6 2nd Minority Primary School of Komotini - Greece

Short profile of the school

The school is situated near the centre of Komotini next to the mosque. Komotini is a multicultural and multilingual city which is located in the northeastern part of Greece. The program of the School is bilingual (Greek and Turkish) and our students are Muslims. Inquiry Based Science Education (IBSE) has been applied in the school since 2016.

A brief history of Go-Lab and the school

Marina Molla was the first teacher of the school to be introduced to Go-Lab. Marina first heard about Go-Lab in 2017 through the PLATON project (PLATON is a spin-off Erasmus+ project of Go-Lab). She was first trained on Go-Lab during the PLATON workshop which was held during the "Open Schools for Open Societies Conference 2017" in Athens. Later, she and the rest of the educators who decided to join Marina in PLATON and Go-Lab activities were also trained online by members of the PLATON team who are also project partners of Go-Lab. The Go-Lab team consists of three educators until now: Marina Molla, teacher; Katerina Chatzopoulou, teacher; Pygmalion Mylonas, P.E.

During the summer of 2018 Marina made her first ILS, "Astronaut Academy" which was published and characterized as an example Greek ILS. https://goo.gl/GaXWCQ

The use of Go-Lab in the school

Marina shared her knowledge and experience with her colleagues Katerina Chatzopoulou. This school year (2018-2019) they have used 2 different ILSs in the same classroom. The students reportedly enjoyed the activities very much. The pictures below show the students working on teams on Marina's first ILS, Astronaut Academy. They are trying to implement the complete Inquiry Cycle.

The Go-lab Experience – Teachers

Now the team plans to have a workshop for the whole teaching staff in our school which our school administration supports. They plan on meeting with the parents to discuss about our work.

The Go-lab Experience - Students

While using Go-lab many great things happened in the school:

★Collaboration; ★Excitement; ★Involvement; ★Curiosity; ★Inquiry; ★Problem solving; ★Creativity; ★Having a great time

Inspired by the Astronaut Academy ILS they have also made a Planetarium out of carton and wooden skeleton. At the end of the (2016-2017) school year they set it up in the amphitheater of the 4th Gymnasium and presented it to our whole school (125 students and to the parents of the participating students) and the 6th graders of 4 other Primary Schools of our town (around 80 students). During Space Week 2018 the work was presented to the whole 8th and 9th grade of a Gymnasium in Komotini (230 students).

2.7 Canisius R.K Scholengemeenschap - Netherlands

Short profile of the school

Canisius is a school in the Eastern part of the Netherlands and has two locations. The first location is situated in the city of Almelo and has now 1079 students with an age range from 12 till 18 years old. In Almelo the levels of education are VMBO-T, HAVO and VWO. The second location is in a rural area in the village of Tubbergen. This location has 722 students with an age range from 12 till 16 years old. In Tubbergen the levels of education are VMBO-B, VMBO-K, VMBO-(G)T, HAVO and VWO. The students in the highest tracks, HAVO and VWO, only stay in Tubbergen for 2 years and then move to the Canisius location in Almelo. The school does not have a specific STEM profile and is at the very moment trying to implement Inquiry Based Science Education at the VWO department.

A brief history of Go-Lab and the school

In 2016 one single teacher introduced Go-Lab to the school. That same year two physics teachers and a biology teacher from Tubbergen followed a Go-Lab introduction training and widely spread the product throughout the school. These early adopting teachers chose for Go-Lab because it was free of charge and added some missing component to the teaching method they use.

The use of Go-Lab in the school

The teachers at Canisius mostly use Golabz as a repository or database to search for online labs that can support the teaching method. But also, a range of premade Inquiry Learning Spaces are used during their lessons. The past couple of years several projects have been started that included one or more components from Go-Lab and/or Graasp. One of the projects worth mentioning is a project that is still active and attempts to improve the research skills of students. For this project materials including some inquiry learning spaces have been developed by a group of skilled teachers. Quite some physics and biology teachers also show and use the labs as found on Golabz on their interactive blackboard to clarify and simplify difficult subjects that they are teaching.

The Go-lab Experience – Teachers

Most teachers at Canisius are not creating their own ILSs regularly. This is mainly because teachers find it is too time consuming to create an ILS that matches the quality of the teaching method. But on the other hand, teachers enjoy working with the different components Golabz provides. They trust the added value of inquiry learning and see that students enjoy working with the materials. In general, Canisius teachers are using Go-Lab on a regular but not a daily basis. Nevertheless, the use of the materials provided by Go-Lab is growing by the year.

The Go-lab Experience - Students

In 2011 Canisius was one of the first schools in the Netherlands that introduced Bring Your Own Device education for all students. This early adoption of ICT in the school resulted in a student population that is not easily impressed by digital learning materials. This might result in the given that students of Canisius in general do not prefer working with Go-Lab more than working with other digital materials. On the other hand, when Go-Lab is compared to written assignments students prefer working with Go-Lab.

2.8 Escola Dr. Horácio Bento Gouveia - Portugal

Short profile of the school

Escola Dr. Horácio Bento Gouveia is a public school in Funchal, the capital of the main island of the Archipelago of Madeira. This 40-year-old school was renovated in 2004 with new buildings and modern equipment. It receives almost 1700 students from the 5th to the 9th grade (10-15-year-old), which is about 10% of all students of that age of the Archipelago. The school welcomes every year a multifaceted spectrum of students with different socioeconomic levels. School rankings have put *Escola Dr. Horácio Bento Gouveia* as one of the best public schools in the Archipelago, and nationally, around the 200th place out of 1050 schools (private and public schools), which is a very good result, considering its geographical and socioeconomic place.

A brief history of Go-Lab and the school

In January 2014, NUCLIO offered a certified teacher training course in Funchal, *Hands-On Astronomy - Discover the Cosmos*, which covered several astronomy contents and hands-on resources for the classroom, but also introduced the Inquiry Based Science Education methodology. It was the first time the group had contact with inquiry and their final assignment was to prepare an inquiry lesson using the resources they had learned. The methodology was extremely well received. During the training, the Go-Lab project was presented and two teachers, Ana Lúcia Vasconcelos and Fernanda Maria Gama de Nóbrega Freitas, who taught Physics & Chemistry at *Escola Dr. Horácio Bento Gouveia,* were extremely interested in the project. Both of them decided to apply for a Comenius grant and attended the Comenius Training Event “Astronomy: Online Labs for Inquiry Minds”, organized by NUCLIO and the University of Twente, which took place at the University of Twente in April 2014. Still wanting to be more proficient with Go-Lab, both Ana Lúcia and Fernanda attended the Go-Lab Summer School 2014 in Greece, July 2014.

During the 2014/15 school year, Ana Lúcia and Fernanda started implementing Go-Lab in their classes using the material they had produced in their trainings. They were so pleased

with their experience that they thought it would be advantageous to have more teachers in the school using Go-Lab. Answering their request, NUCLIO came back to Funchal in February 2016 and offered a certified teacher training course of 25 hours "Astronomy Online Labs: Go-Lab I". It was an intensive course, but it allowed to explore the IBSE methodology and the Go-Lab ecosystem to a satisfying level. When evaluating the course, teachers showed a great appreciation for the inquiry methodology and the Go-Lab ecosystem, stating they were going to try to use Go-Lab in their classes. They pointed out that the main difficulties they expected to encounter towards using Go-Lab would be the extensive curriculum they are obliged to fulfill and the difficulties in using the computer room with stable internet.

Out of the 14 teachers in the course, 8 were from *Escola Dr. Horácio Bento Gouveia* and they all teach Physics and Chemistry.

The use of Go-Lab in the school

For the last two school years, four teachers besides Ana Lúcia and Fernanda have been implementing Go-Lab in their classes. Each teacher uses an average of 2 to 3 different ILSs per year and when they implement an ILS, they do it with all 4-5 classes they teach, which means more than one hundred students experiencing the ILS.

Go-Lab is used both in Physics and in Chemistry from the 7th to the 9th grade. Most used ILSs include the simulator Craters on Earth and Other Planets, Balancing Chemical Equations, Build an Atom, among others. Most teachers use primarily the ILSs they developed within the teacher training course. They find it quite time consuming to create a totally new ILS from scratch, but they copy ILSs from the Go-Lab database, translate and make small adaptations.

Although Go-Lab is not mandatory, the department welcomes its use and helps teachers having easy access to the computer rooms when they need. Ana Lúcia has been assigned time in her schedule (2 hr) so she can use it to implement Go-Lab activities with her students and to test the Graasp platform and online labs.

The Go-lab Experience - Teachers

This school community of Go-Lab teachers use the ecosystem because they experimented it and had good results. They believe it helps them teach in a better way. Through the project, they have become acquainted with inquiry, understand its importance, and Go-Lab helps them use inquiry in their classes. Also, they find the online labs very useful for providing more practical activities besides the traditional laboratory ones. They talk among themselves about their experiences in using ILSs, which ILSs they use or find interesting, and help each other.

The Go-lab Experience - Students

The success of implementing Go-Lab in this school is partly due to the reaction of students to the use of ILSs in the classroom. They are very enthusiastic with the Go-Lab activities, to the point of frequently not wanting to leave for the recess, preferring to continue working. They particularly enjoy the use of computers in the classroom and the use of online labs (which they hadn't used before the Go-Lab activities). The fact that they end up using Go-Lab more than once during the school year helps them familiarize with the inquiry methodology.

2.9 Gallego Gorria Primary School - Spain

Short profile of the school

Gallego Gorria Primary School, http://www.gallegogorria.hezkuntza.net, is located in Padurako Guduaren Kalea, 17, 48012 Bilbo, Bizkaia, Spain. This public school is situated in a socio problematic community with large number of migrant families and families with low socioeconomic and poor education status. That is the cause that students yearly show the low standard test results compare with students' results from other Bilbao communities.

A brief history of Go-Lab and the school

From 2015 Berritzegune together with Go-Lab team of the University of Deusto are offering the course in frame of the Prest Gara programme (for 2019 year the reference is 265 code course: This department is a part of the Education Department of the Basque Government. It is in a charge of the innovation in education.

In 2015-2016 academic year Almudena de la Peña and Isabel Ruiz completed this course. During the 16 hours course they learned how, in the first place, find the online laboratory and inquiry apps that fit to lessons objectives, and, in the second one, design and create the ILS. Additionally, in this year more two teachers Josefa Miñambres and Mireia García had used the ILSs created by Almudena and Izabel.

In 2016-2017 academic year, Almudena invited in the team two additional teachers - Mikel Amezaga and Saloa. They implemented ILS in their classrooms with students. In 2017 Mikel Amezaga continue his carrier in primary Juan Ramón Jiménez School. In this new school, he involved two teachers in the project, Enrike Arribas and Amaia Tejedor combining three school subjects Science, English and Technology / Informatics.

Besides the Prest Gara training sessions, Almudena and Isabel participated in the Go-Lab Marathon Summer School, 2016; Mikel and Amaia went to the Go-Lab Marathon Summer School, 2018.

From Sept. 2018 Mikel Amezaga is a director of Mina del Morro Primary School**.** The University Deusto team is planning to collaborate with this school and train the teachers of this school to the Go-Lab ecosystem and inquiry pedagogical approach.

All these three mentioned schools have insufficient level of laboratory equipment, low use of the new technology during school lessons, and conservative teaching style. The abovementioned reasons explain the interest young in-service teachers to apply the Go-Lab developments in the classroom.

The use of Go-Lab in the school

Depending on the school year, 2-4 teachers simultaneously apply the Go-Lab in their classes. The age of students is 10-12 years old. There are no requirements for "formal decision" by the schools' STEM departments – at the beginning of school year a teacher describes pedagogical approaches, technological instruments and didactic materials that will be used in her/his classroom during the lessons. Because of such policy, the Go-Lab is not mandatory for all teachers. In general, they use it sporadically when they have ILS fit to

the topic of lesson. The ILSs cover three subjects – Science, Technology, and English. English is employed to introduce the scientific vocabulary and expression for pupils.

Usually, they create and therefore apply their own ILS e.g. https://www.golabz.eu/ils/berotegi-efektua,

https://www.golabz.eu/ils/free-fall-on-the-earth-and-on-the-moon,

https://www.golabz.eu/ils/espazioaren-zehar-ibiltariak-meteoritoak

although, in some cases they prefer to adapt already existing ones e.g. https://www.golabz.eu/ils/fotosintesia. The students perform the complete five-phase Inquiry Cycles scenario.

The Go-lab Experience - Teachers

During the last decade, Spanish government stopped to offer fixed positions in schools. As an effect, the young teachers work in a school temporally during one-two years, then they should apply for new position in new school (as an example, Mikel Amezaga carreer path). The main pros of such movement, the Go-Lab distributes among teachers employing peer professional community; the cons, the school team can lose most experienced Go-Lab active core player.

The long collaboration with Gallego Gorria Primary School demonstrates the permanent interest teachers to the Go-Lab ecosystem. Working collaboratively and interdisciplinary with their colleagues, they open new learning horizons for their students as well. The teachers who use the Golabz reporsitory believe that IBSE is most powerful tool for development scientific competences by students. Moreover, the Go-Lab is one of the best web instrument that support them in this job.

The Go-lab Experience - Students

Implementing the ILSs in the classroom teachers notice the students' enjoyments, and higher participation and engaging during class activity. This was an essential reason for the teachers of Gallego Gorria Primary School to persist with Go-Lab and promote by training and involving other members of the school team to explore the Go-Lab for a teaching practice.

2.10 Colégio Antares - Brazil

This school was included to the case studies, as recent project activities have been carried out in Brazil. It offers a glimpse to other parts of the world where Go-Lab is being picked up and used and offers some comparison.

Short profile of the school

Colégio Antares is a private school, located in Americana, São Paulo, Brazil, maintained by FAEC (Fundação Antares de Educação e Cultura). FAEC is a foundation by a group of parents. It ranges school from kindergarten to high school. It is in an urban area. Onsite, we have our own lab, but we also think that online labs are very important for the learning process.

The school doesn't have a STEM profile, but they have already used IBSE in their classes and as an inquiring project developed throughout the school year.

A brief history of Go-Lab and the school

Go-Lab project was introduced to our school by a former student, Danilo Garbi Zutin, a PHD student at Carinthia University of Applied Sciences. In the Go-Lab project, he was a researcher and software developer in the applied technology education area. In this project, he developed the platform to connect the remote and virtual labs to the Go-Lab´s system.

Currently, there are only two teachers using Go-Lab in a project named OInC – Oficina de Investigação Científica, which is based on scientific inquiring methods. They have learned how to develop an ILS by observing others ILS already published and through tutorial videos on the official site.

The use of Go-Lab in the school

There are two teachers using Go-Lab as an extracurricular activity named "Oficina de Investigação Científica - OInC". This activity has been implemented over three years and it´s offered after regular classes. Another teacher showed interest in learning about the use of this teaching learning tool. OInC is a project elaborated and proposed by the school Science teachers and approved by the school coordination after proposal submission and solicitation of the implementation in the curriculum.

There are 12 projects (12 ILS´s) in Biology, Chemistry, Physics and Math that have been developed. All the ILS´s were created by the two teachers, but one of this ILS was based on a preexisting ILS created by Danilo Zutin, the person who had presented the Project to us. Over the activity, the complete Inquiry Cycle was implemented: from the orientation to the discussion/conclusion.

The students who join Go-Lab are between the ages of 11 to 15 years old (from 7th to 9th grade) and they attend classes together, we don´t separate them by grade.

The Go-lab Experience - Teachers

Teachers very much like the Go-Lab structure because the Inquiry Learning Method in Science contributes to making the student autonomous in researching knowledge and give them the opportunity to become more responsible by their learning process. Teachers believe that it is an effective method once it includes the possibility of hypothesis survey, leading an investigating process (by simulators, remote labs or experiments in our own lab) and analysis of results.

Besides this kind activity has enabled the use of math knowledge in the statistics analysis of the obtained data, table construction and graphic design. Thereby, the students are learning how to use data sheet like Excel, allowing them to know how to use information and communication technology tools in the classes.

All the planning and application of the Project are done by the two Science teachers, who are graduated in Biology. Lately, other teachers have been searching for information about Go-Lab to check the possibility of introducing this kind of activity in their classes and also giving suggestions to create ILS´s in their areas.

The Go-lab Experience - Students

The students seem to like Go-Lab, since the participation isn´t compulsory. Those who participate are interested in this kind of activity and they keep up their participation over all the school year. Most of them enroll the project again in the following years.

On the last ILS we included an evaluation quiz about how the students realize their learning throughout the meetings and compare their previous and after project knowledge. The data obtained from this quiz will give us valuable information.

This activity allows the students to develop inquiring skills enabling a more effective learning on the proposed themes. In addition, since the subject is broad in general, it promotes interdisciplinarity and usage of what the students have learned during classes.

With the participation in the meetings, the students start becomes more questioning to elaborate hypotheses, understand the investigation is based on the observation and analysis of the records obtained through the experiments and, most of all, they relate all the stages of the investigative process to elaborate a discussion and reach a possible answer for the initial questioning.

Go-Lab brings students closer to the scientific making and helps build the idea that knowledge is dynamic and broadens the exchange of information between researchers. This activity also enables group work development, encouraging behavioral skills such as listening to the other, developing a respectful criticalness, dealing with diversity of ideas and opinions. As a result, experiencing a discussion capable of adding the group's participation as a whole.

3. Empowering Trainers Through Go-Lab Courses

As discussed above, the focus in the remaining months in Next-Lab will be shifted from providing numerous independent, one-off workshops to introduce new teachers to Go-Lab, but to creating complete, exhaustive and complimentary Go-Lab courses. Partners have created in the past numerous stand-alone workshops, based on the needs of the teachers in their country, or on the program and agreed topics of international training events. The goal of these courses will be to offer an exhaustive collection of all needed training, seminars and workshops that offer teachers a pathway to progress through the whole "Teacher Journey").

The teacher journey as presented first in D1.1. is a mix of the experience in working with teachers during workshops and summer schools, as well as the Graasp / Golabz technical user data and profiles. Creating such a graph with the different user profiles was a first important step to become aware of the overall categorise and the different types of users in order to distinguish between their activities, knowledge and skills. As the next step, the partners were able to create (additional) targeted workshops that address specific skill and competence levels, based on the (perceived and measured) needs of the teachers.

For the project, the next step is to integrate the existing material and workshop and to create a modular training program, that combines in a structured and meaningful way the various workshops and prepares the roadmap and pathway for Go-Lab training. The "Go-Lab Courses" entail all the information and materials needed to provide a complete training on the overall Go-Lab Ecosystem. This way, Next-Lab partners can better organise existing training, but in addition in offers also the opportunity to create a specific "Next-Lab / Go-Lab product" that could be licenced to 3rd party training providers in the sustainability efforts.

In the next months, the project will define the course contents in the form of syllabuses for each course. At this moment, we expect to have (at least) three different basic courses, that possibly could be extended with additional extra-courses or workshops on specific topics or exercises. The syllabus of each course will include:

- Course description
- Course objectives and expected outcomes
- Definition of target group / Target Go-Lab User profile
- Prerequisites and prior knowledge
- Instructional methods and activities
- Course Certification Requirements
- Course duration, content and structure / Topics

The syllabus will describe what participants can expect from the course, if the course addresses their competence level and needs and clearly set us the expectations towards the outcomes and workshops. This will be the public part of the courses. A first draft and working example of such a syllabus can be found in the Annex I.

In addition to the public part of the syllabus, the consortium will create specific teachers' guidelines for each course, providing explanation and instructions for each workshop. The "workshop unit description" will provide specific guidelines for each workshop, including:

- ✓ Expected duration of the workshop
- ✓ Specific learning goals for the workshop

- ✓ A description from the teachers' point of view
- ✓ A link to specific support material created for the workshop
- ✓ Links to additional support material at the Golabz support area

A first draft and working example of such a workshop description can be found in the Annex II. The basic courses are expected to be finalised by summer 2019, and ideally can and will be applied to the Go-Lab Summer schools. The additional courses and any other work related to this task are planned to be finalised by the end of 2019.

As part of the Go-Lab Courses development, the teacher journey will be analysed and wherever necessary, adapted to the needs of the users and the latest user data. This serves two purposes:

a) for the project to have a better understanding of the steps, user profiles and to have a common understanding of the basic Go-Lab skills and competences needed for each step.
b) This overview will also be made public so that the Go-Lab users can self-evaluate their perceived Go-Lab knowledge. This will help them to choose the specific training that they will need in order to progress in the journey. But this will also help the trainers to target and custom-make the workshops to the participants.

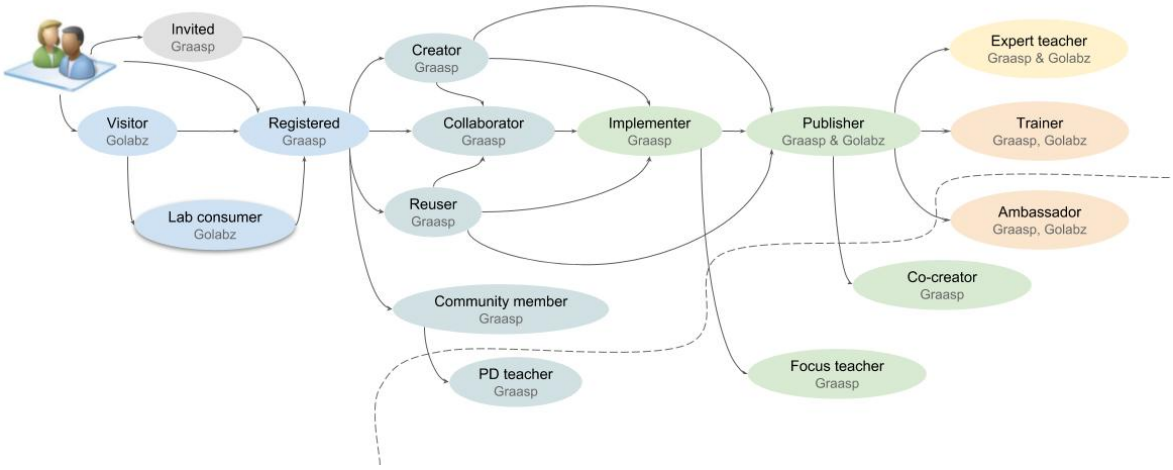

Figure 1: The Go-Lab Teacher Journey

Table 1: Example of the Teacher Journey competence grid

Go-Lab Profile	Prerequisites Skills / Competences	Go-Lab Training Needs		
		Pedagogy	**Graasp / Golabz**	**Go-Lab apps / tools**
Visitor / Invited / Lab Consumer				
Registered				
Creator				
Collaborator				
Re-user				
Community Member				
PD teacher				
Implementer				
Publisher				
Focus teacher				
Co-creator				
Expert teacher				
Trainer				
Ambassador				

4. Empowering Teachers Through International Training

4.1 Multiplication and Sustainability in International Training Events

As described in D2.1 each course is focussing on a specific theme, competence domain or target group. The courses also serve to test and try out new aspects of Go-Lab. Following the Next-Lab project review in June 2018, the consortium decided to shift the focus of the remaining international training events and give more emphasis on the core interrelated issues the project should be focussing on for the remaining months: multiplication and sustainability. Consequently, the topics and target groups for the Winter and Spring school have been adjusted.

Additionally, the consortium decided to try out if the summer schools in Marathon can be driven solely by participants that are using 3rd party funding to attend the course. Therefore, the summer schools in 2019 will be a test-run to see if Go-Lab and the planned workshops generate enough interest that schools and teachers are willing to undergo the process of writing and submitting Erasmus+ KA1 applications. The Erasmus+ program was identified as the most appropriate funding mechanism to offer funding for schools to attend, covering the costs for travel, accommodation and subsistence of participants, but also enabling participants to contribute to the costs of such school by paying a moderate course fee. The income generated should be able to cover at least partially the costs of the organisation of such a school for the organisers.

Below is an overview of the planned events in 2019:

4.1.1 Winter School 2019 - Cascais, Portugal

Date & Location

5-8 March 2019 - Cascais, Portugal / Main organiser: NUCLIO

Concept & Target Groups

Originally, the school in Cascais, Portugal was designed to address the needs of pre-service teachers, one of the main target groups in Next-Lab. However, following the review and its recommendations to focus on multiplication and sustainability, the partners in WP2 agreed to support the activities of WP1 to engage and involve Teacher Training Institutes (TTIs), and shift the focus from students to universities staff teaching at TTIs.

At the last TTIs meeting, a participatory design session and a direct questionnaire were conducted, which helped us identify TTIs needs and wishes. The Winter School is based on the analysis of their feedback.

The TTIs to be invited will include some of the TTIs that have been involved from the very beginning of the project as part of WP1 activities, but also participants from additional, new TTIs will be invited. This way, the project has the chance to involve more, additional TTs that will have the chance to learn how Go-Lab can be integrated into their curriculum for pre-service teachers.

However, the challenge will be that the program needs to take into account two different target groups with various degrees of knowledge and acquaintance with the Go-Lab Ecosystem. To handle these differences, parallel sessions were introduced to the program.

The Go-Lab Winter School 2019 will focus its concept on the following main objectives:

- Share experiences and practices about how Go-Lab is integrated in TTIs

- Discuss how Go-Lab's value and
- Introduce TTIs to the material available to be used for Go-Lab training and workshops
- Explore inquiry and interdisciplinary practical activities
- Introduce different pedagogical approaches with Go-Lab
- Introduce advanced features of Go-Lab
- Train participants in the use of Go-Lab at the beginners and advanced levels
- Develop new ideas how Go-Lab can be introduced to pre-service teachers

Draft Programme

<table>
<tr><th></th><th>Tuesday</th><th>Wednesday</th><th colspan="2">Thursday</th><th colspan="2">Friday</th><th>Saturday</th></tr>
<tr><td>Time</td><td>05-03-2019</td><td>06-04-2019</td><td colspan="2">07-04-2019</td><td colspan="2">08-04-2019</td><td>09-04-2019</td></tr>
<tr><td>09:00-11:00</td><td rowspan="3">Arrival</td><td rowspan="2">Integration of Go-Lab into the university curriculum for pre-service teachers (presentations of TTIs + discussion)

Why use Go-Lab - scientific research</td><td colspan="2">What makes an ILS a good ILS?
Introducing Tips and Ticks for ILS design
Exemplary ILSs</td><td colspan="2">Inter-/ Multidisciplinary approaches in school education:
The Big Ideas of Science</td><td rowspan="7">Departure</td></tr>
<tr><td>11:00-13:00</td><td>Work with Graasp (Beginners)</td><td>Work with Different Scenarios (Advanced)</td><td colspan="2">Flipping the classroom using Go-Lab
Differentiation in an ILS</td></tr>
<tr><td>13:00-15:00</td><td>Lunch</td><td colspan="2">Lunch</td><td colspan="2">Lunch</td></tr>
<tr><td>15:00-16:30</td><td rowspan="2">Registration</td><td>What is Inquiry?
How to introduce Inquiry to pre-service teachers</td><td colspan="2">21st Century skills & Learning Analytics in Go-Lab
Learning Analytics Apps</td><td>Work with Graasp (Beginners)</td><td>Work with Differentiation (Advanced)</td></tr>
<tr><td>16:30-17:30</td><td>The Go-Lab Scenarios</td><td>Work with Graasp (Beginners)</td><td>Work with Learning Analytics (Advanced)</td><td colspan="2">Discussion: new ideas for integration of Go-Lab into the university curriculum
Evaluation of the winter school</td></tr>
<tr><td>18:00-20:00</td><td>Welcome / Introduction / Ice-breaking</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>20:00-22:00</td><td>Dinner</td><td>Dinner</td><td colspan="2">Dinner</td><td colspan="2">Dinner</td></tr>
</table>

Selection process

The NECs of WP2 are in contact with the national partner TTIs, and will nominate participants to join the Go-Lab Winter School.

4.1.2 Spring School 2019 – Tallinn, Estonia

Date & Location

14-18 April 2019 - Tallinn, Estonia / Main organiser: University of Tartu

Concept & Target Groups

The Spring School will focus in more depth on the pedagogical concepts within Go-Lab and their various didactic applications, covering topics such as 21st century skills, differentiation or self-regulated learning. Generally, the school will be very hands-on, meaning that topics will be introduced and then tested and adapted in existing ILSs. This way, participants will get introduced to the theory and have to apply it on the spot in practical workshops.

The Spring School is therefore also demonstration of the wide application of Go-Lab in the school curriculum. Some of the participants will therefore be heads of science departments in schools, policy makers and curriculum developers, so they can see and understand the benefits and possibilities of the Go-Lab Ecosystem.

Consequently, the Go-Lab Spring School 2019 will also address several target groups:

- Expert Go-Lab teachers
- Head of science departments at schools
- Curriculum developers
- Regional policy makers

Draft Programme

	Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**
Time	**14/04/2019**	**15/04/2019**	**16/04/2020**	**17/04/2020**	**18/04/2021**
09:00-11:00	**Arrival**	**What are 21st century skills?**	**Analysis of selected ILSs**	**Hands-on: adapting ILSs to 21st cent.skills and cont.learning approach**	**Participants presentations**
11:00-13:00		**What is contemporary learning approach?**	**Discussion**	**Hands-on: adapting ILSs to 21st cent.skills and cont.learning approach**	**Presentation, reflection, giving feedback (panel)**
13:00-15:00		Lunch	Lunch	Lunch	**Departure**

15:00-16:30	Registration	**Seminar: how to link these pedagogical principles, how to design an ILS in taking these into account**	**Differentiation in ILSs**	**Presentation, reflection, giving feedback (panel)**	
16:30-17:30	**Welcome / Introduction / Ice-breaking**	**Discussion and presentations**	**Suggestions for developing new ILSs or adapting existing ones based on shared view on pedagogical principles**	**Revision**	
18:00-20:00	**Dinner**	**Dinner**	**Dinner**	**Dinner**	

Selection process

The selection follows a two-step approach:

First NECs are given the chance to nominate teachers that fit the profile. From early 2019, an open call will be published where also participants from non-project countries have the chance to apply.

4.1.3 Summer Schools 2019 – Marathon, Greece

Date & Location

30 June – 5 July & 7-12 July 2019 – Marathon, Greece / Main organiser: EA

Concept & Target Groups

The project will offer two summer courses, one addressed at beginners and one for more experienced Go-Lab users. Both courses will include presentations followed by practical sessions and workshops focusing on:

- Concepts and skills of learning-design, inquiry processes and multidisciplinary teaching
- Preparing, uploading and sharing digital learning resources and activities
- Inquiry-based learning activities for use in the science classroom
- Familiarization with online labs and the educational resources of Golabz
- Introduction to 21st Century Skills and the Go-Lab learning analytic tools
- Hands-on sessions working on online labs and resources related to science.

However, the main challenge for the project is not regarding the concepts or programs. But the project would like to test if such courses can be (at least partially) funded by other means than using the Next-Lab budget. It is therefore a sustainability exercise to see if there is enough interest among schools and teachers to go through the process of preparing and submitting an application that would allow them to be trained in Go-Lab. Next-Lab partners are promoting the course among the schools in their country and offering support to prepare and submit funding proposals that could finance the participation of teachers to the course.

Namely, the Erasmus+ program[3] offers specific action (Key Action 1) that supports the mobility and training of teachers. The draft programs can be found here: http://golab.ea.gr/programme

Ideally, we would like to be able to run both courses without using the Next-Lab budget. If this is successful, the project can organise additional Go-Lab courses at the end of 2019.

Selection process

The courses are open to every teacher that has funds to cover the costs for travel and accommodation, and the course fee. Teachers can choose if they fit to the profile of the course for beginners or more advanced Go-Lab users.

[3] http://ec.europa.eu/programmes/erasmus-plus/

5. Empowering Teachers Through the Go-Lab Support Facilities

The concept of the remodeled support area and the new approach to the online training courses was introduced and detailed in deliverable D2.5. Following is an update on the work progress and changes that were made from the initial plan.

5.1 Support Area

The goal of the new support area remains to assist, guide and train Go-Lab users to use the full potential of the ecosystem, by providing them with the pedagogical and technical support they need to implement the Go-Lab ecosystem in the classroom. Furthermore, the support area connects the users to the Go-Lab community, national ambassadors and teacher training institutes and provides them with the project's news and updates.

The content of the support area will be designed to reflect the updates of the Golabz and Graasp platforms, including the Apps, Labs and ILSs. It will be presented as micro-content to facilitate usability and access. Moreover, it will follow a user-oriented structure as presented in Table 1.

Table 1: *Tentative structure of the new support area.*

Introduction to Go-Lab	**How to use Go-Lab**	**Pedagogical Support**	**Teacher Training**	**Go-Lab Community**
Why use Go-Lab (UT/EUN)	How to create ILS (UT/EUN)	Learning Theories (EA)	Training Modules	Go-Lab in your Country
What is IBSE (UT/EUN)	How to set up Apps (UT/UCY)	Big Ideas of Science (EA)	Training Institutions	Online Community
What is the Go-Lab Initiative (UT/EUN)	Learning Analytics (UT/UCY)	Pedagogical Scenarios		Call for Teachers
Intro to Go-Lab Ecosystem (UT/EUN)	How to design a good ILS (NUCLIO)			
How to start with Graasp (UT)				

In deliverable D2.5 we proposed that the support area content would be downloadable in several languages as pdf files in each page and section, as well as in the Compile your Manual page. After further consideration, and to facilitate the maintenance of the support area and not duplicate content, the download feature will only be available on the Compile your Manual page, where a list of the support area files will be presented. The user can

then select the language in which the file(s) will be downloaded in, then either “select all” or select specific files to download.

As seen in Table 1. “Introduction to Go-Lab”, the support area provides more than just a video introduction to the Go-Lab Ecosystem. In fact, this section is dedicated to informing Go-Lab visitors and users about the Go-Lab project and its importance in STEM education at the pedagogical and technical levels, as well as the different affiliated projects using the ecosystem. This section targets educators and interested visitors and intends to attract additional cooperation projects and initiatives.

Learning Analytics has been explicitly added to the “How to use Go-Lab” section, to highlight their use and importance in classroom implementations. Learning analytics apps are used to support the learners’ self-reflection and self-regulation skills, as well the teachers’ follow-up and evaluation of the learners.

The “Pedagogical Support” features the pedagogical framework of the Next-Lab project and focuses not only on inquiry-based science education, but also on 21st century skills and different teaching scenarios. Additional learning theories and approaches, such as collaborative learning, self-regulated learning and flipped classroom will be included. These are currently represented under Pedagogical Scenarios, however, providing the theoretical backgrounds behind the scenarios, and the effect of using these learning approaches on students’ performance would motivate the users and provide them with more confidence to implement these different scenarios. The Big Ideas of Science are also further elaborated to support teachers make more concrete connections between the concept and their teaching practices.

“Teacher Training” is an essential part of the support provided to the teachers. Teachers can choose between online training using the *Training Modules* or contact the Teacher Training Institutes for face-to-face training. The Training Modules will be further discussed in the next section.

Lastly, the “Go-Lab Community” pages inform users how to contact and/ join the Go-Lab Community, including the Next-Lab Ambassadors and Expertise Centers (NECs).

The work on the content of the Support Area started in October 2018. Work has been allocated to the different partners, as shown in Table X, so that each partner contributes to the Support Area and/or the Training Modules. So far, 70% of the content of the Support Area has been completed. We are planning to have the content ready to be published on the support page in the coming three months.

To ensure that the content of the support ara meets the needs of the teachers, there will be a user testing before publishing. We will select a few teachers, with different levels of Go-Lab expertise (beginners and an advanced users) to give feedback on the Support Area contents and presentation.

5.2 Training Modules

The concept of the newly designed online modules was described in detail in deliverable D2.5. The micro-modules are now presented as standalone views of ILSs to familiarize users with the Graasp platform and have them experience ILSs from the students’ perspective. Simultaneously, they provide the pedagogical rationale and the technical support behind each phase of the ILSs.

The goal of the modules is to train teachers pedagogically and technically on how to best use the Go-Lab ecosystem with all that the capacities it offers. While selecting which training

modules were to be developed, it was decided that there should be two types of modules: informative and exemplary. Informative modules are designed to provide information to teachers about specific pedagogical or technical concepts. On the other hand, exemplary modules are designed for teachers to have a real feel of how a student experiences an ILS and therefore are actual ILSs.

Table 2 shows the tentative structure of the training micro-modules. Each module implements a different learning approach and is designed around a different learning scenario allowing users to experience with all the scenarios and learning approaches. Moreover, different sets of apps will be presented in each module so that in the end, the user has been exposed to a considerable number of apps.

Table 2: *Tentative structure of the micro-modules.*

	Module Name	Module Type	Scenario	Partner
1	Understanding Inquiry Learning Spaces	Informative	NA	EUN
2	Basic Inquiry Learning	Exemplary	Basic	NUCLIO
3	Guided Inquiry & Self-Assessment	Exemplary	Basic	NUCLIO
4	Using Learning Analytics in ILSs	Informative	NA	UD
5	Open Inquiry & Cooperation	Exemplary	Jigsaw	UCY
6	Self-Regulation	Exemplary	Self-regulated	TBC
7	Collaboration & Peer-Assessment	Informative	Six Changing Hats	ULEIC
8	Collaborative Learning	Exemplary	Learning by Critiquing	UTE
9	Flipping the Class	Exemplary	Structured Controversy	UTU
10	Differentiated Learning	Informative + Exemplary	NA	ENS

Important topics, such as cognitive load and ILS design, are integrated in the micro-modules as pedagogical and technical notes for the teachers. Remarks related to the importance of monitoring the cognitive load during the ILS, or details of what makes a good ILS, appear on the Teachers Notes section of the learning phases of the exemplary modules.

The micro-modules also focus on 21st century skills, such as collaboration and reflection. These skills are covered on different modules: module 3 - self-assessment; module 5 - cooperation, module 6 - self-regulation, module 7 - collaboration and peer -assessment and module 8 - collaborative learning.

Work has been allocated to the different partners, as shown in Table 2. To test how the new concept of the training modules turns out, we started with the first two introductory modules, one informative and the other exemplary, in November 2018. These modules are now being finalized so there can be an evaluation of the effectiveness of the new design. This evaluation will be done not only by the partners but also by a couple of teachers. Work on the following modules is expected to start in January 2019 and we plan to have them finalized by June 2019, so there can be a user testing by teachers, similar to the procedure we described for the Support Contents. We are planning to have the training modules ready to be published before the end of the project.

6. Annexes

Annex I - Go-Lab Course I - Beginners level

Syllabus

Course Description

The **30h** - Go-Lab Course – Beginners aims to introduce STEM teachers of primary and secondary school education to the principles of **Inquiry Learning,** and how this can be successfully combined with the use of **online or remote labs.** Participants will learn how digital "**Inquiry Spaces**" integrate the pedagogical and technological aspects and how the tools and apps of the Go-Lab Ecosystem can be applied **impactfully and meaningfully in a classroom setting.**

This Go-Lab Course is specifically designed for teaching professionals in STEM disciplines (Science, Technology, Engineering, and Mathematics) with no or only little prior knowledge of Go-Lab. Participants of this course will understand and practice the basic pedagogical approach and technical tools to adapt or create learning spaces that offer engaging and interesting science lessons. that allow students in primary and secondary school education in a structured, but also self-regulated way to apply the steps and experience the processes of scientific inquiry.

It will introduce teachers to the use of online labs and experimentations and how they can be combined with inquiry-based science teaching techniques to develop, improve and enhance their teaching skills and practices.

Course objectives and outcomes

At the end of the course, participants will be able to:

1. Explain the basic principles of **Inquiry Learning**
2. Demonstrate understanding of the principles and phases of the **Go-Lab Inquiry Cycle**
3. Comfortably use the main functions and features of the Go-Lab authoring platform **Graasp**, to create or copy and adjust (existing) learning spaces to their own Graasp user portfolio
4. Create simple digital and online-based "**Inquiry Learning Spaces (ILS)**" that reflect the basic steps of scientific inquiry and the Go-Lab Inquiry Cycle, and that can be applied as STEM lessons in educational school classroom settings
5. Navigate the **Go-Lab Ecosystem** to find and integrate (subject-, age- and language-) appropriate labs, apps in (new or existing) learning spaces, as well as know where to find additional instructions and support

6. Understand the purpose and functionality of the main **Go-Lab apps** for each phase of the Go-Lab Inquiry Cycle and ILS, and how to manipulate their settings, features and functions
7. Discuss the potential and advantages of Go-Lab to create inter-disciplinary science lessons based on the **Big Ideas of Science**

Target group

- Teaching professional in STEM subjects in primary school level with no or little prior knowledge of Go-Lab
- Teaching professional in STEM subjects in secondary school level with no or little prior knowledge of Go-Lab

Course is addressed to the following Go-Lab User profiles:

✓ Visitor / Invited	✓ Re-user	~~Focus teacher~~
✓ Lab Consumer	✓ Community Member	~~Co-creator~~
✓ Registered	~~PD teacher~~	~~Expert teacher~~
✓ Creator	~~Implementer~~	~~Trainer~~
✓ Collaborator	~~Publisher~~	~~Ambassador~~

Prerequisites and prior knowledge

- First experience in the use of online/remote labs and experiments
- STEM teaching professional in primary / secondary school education
- Computer with internet connection
- Basic computer and email skills, effective internet user
- User account in Graasp (https://graasp.eu/signup)
- Registration to Graasp Training Event Space in the Go-Lab Community
- Concrete idea for a science lesson / experiment

Instructional methods and activities

The Go-Lab Course – Beginners is designed to be a highly engaging and interactive course. Participating teachers should work (preferably but not mandatory) in small groups and thus be able to collaborate with other teachers to discuss ideas and exchange experiences and to co-create common lessons as Inquiry Learning Space. Each group (or individual participant) will be asked to create an ILS during the course that will encompass all the main features of a successful inquiry-based (inter-disciplinary) science activity.

Each workshop / unit / module will have an instructional component, a technical component, and hands-on component. The course consists of units that can be lectures and presentations. Each unit is always including practical exercises or hands-on activities and may also include periods of autonomous work, self-study or testing.

Course Certification

To get the official course certificate, participants need to showcase and explain their (own / co-created) ILS to other course participants / tutors. The ILS needs to

- follow the basic principles and phases of inquiry learning,

- contain the appropriate apps per phase, which need to be adjusted to the topic, student level, and language,
- include at least one online lab

Course duration, content and structure / Topics

All course materials will be included in the Graasp Event space that will be created and where all participants must register in.

The course is divided into three learning modules over the course of the **30 hours duration**. Each module is divided into specific units and workshops that support the topic of exploration. Each specific unit will have a PowerPoint presentation, links to ILSs or other exemplary resources, and/or worksheets and exercises. Each unit is meant to be for face-to-face training.

- **Module 1 – Pedagogical Principles and Go-Lab**
  - Inquiry Learning in STEM – What is Inquiry?
    - Inquiry Learning
    - Mystery boxes
    - Inquiry Learning in School Education – practical examples and activities
  - The Go-Lab Inquiry Cycle and its phases
  - Inter-disciplinary science teaching – The Big Ideas of Science
- **Module 2 – The Go-Lab Ecosystem**
  - Working with the Go-Lab Ecosystem – An introduction / Orientation
  - The Authoring Platform Graasp
    - Using Graasp – Main features and functions
    - Spaces vs. Inquiry Learning Spaces
    - The Go-Lab community
  - The Go-Lab Apps – the most-used apps per phase
  - The Support Platform
- **Module 3 – Principles of ILS design**
  - What makes an ILS a good ILS?
  - Examples, Tips & Tricks for more effective ILSs

Annex II - Modules and Workshops / Unit description

- **Module 1**: Pedagogical Principles and Go-Lab

Workshop Title: Inquiry Learning 101 - Inquiry learning in (primary/secondary) education

Learning Goals

- Goal1
- Goal2
- Goal3

Prior skills & knowledge

Workshop description

Go-Lab Support Material

Additional Material Needed