Go-Lab

Global Online Science Labs for Inquiry Learning at School

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Report on development of the virtual Go-Lab user community

Joint Deliverable of

Report on development of the virtual Go-Lab user community – V2 (D6.7)

Report on Implementation Activities Phase-C (D7.6)

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Executive Summary

This document is describing and summarising the outcomes of two main interconnected characteristics of the work implemented in WP6 – “Community building and support” and WP7 – “Large-scale pilots”. It presents on the one hand the designed and implemented methodology used to engage teachers to become part of the Go-Lab community and describes briefly the implemented actions, focusing on the past 12 months. This is followed by an analysis of the impact of the community building activities on the use of the Go-Lab system and implementation, comparing the user data for the last two pilot implementation phases (October 2014 – September 2015; October 2015 – July 2016, using various available usage data from Google Analytics and the Graasp platform. In the third part, the deliverable presents the results of the large scale pilots that have taken place in Go-Lab partner countries and its effects on the creation and use of ILSs in educational settings.

Over the past 12 months, the focus of the community building activities had been to gather the feedback and to understand the experience of teachers in the use and piloting of the system. To this end, 17 Summative Workshops (SW) with 191 teachers have took place in 13 countries all over Europe. Generally, participants are very positive towards the use of Go-Lab, considering it as a good tool that supports their teaching. Over 95% of the participants of the SW online survey stated that they will continue using Go-Lab in various ways to support their teaching. Furthermore, Go-Lab helped to improve the proficiency of 70% of teachers in the use of the Inquiry Based Science Education (IBSE) concept.

In countries where the Go-Lab Community Support Framework & Methodology was fully implemented, better results in the creation and implementation of Inquiry Learning Spaces (ILS) have been observed. Between October 2014 and July 2016 a total of 6517 users from which 3877 authors of ILSs are recorded in the Graasp system. In the same period 1692 teachers were trained in physical or online workshops in the use of Go-Lab for their teaching. For every teacher directly trained in a workshop 4 additional users were engaged by them and were registered in Graasp, and on average 2.29 users per trainee become authors or co-authors of an ILS. There are strong indications that physical training events and the direct contact to Go-Lab partners led to a higher creation and implementation of ILSs.

As part of the piloting activities, a constant and wide uptake of Go-Lab was realized over the past 12 months. On average 200 users per day were utilizing the services and tools of the Go-Lab system and more than 768 ILSs were implemented in schools (44% of cases during in-school hours), with an average repetition rate of 2.8 times, reaching an estimate of more than 40,000 students. During the implementation phases of the project, a large series of activities, both of teacher training events and in-classroom activities, were organized and conducted by Go-Lab partners across countries. In total, 1692 teachers from 1041 schools attended the teacher trainings, and 4283 students from 218 schools participated in the educational activities that partners conducted.

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1. Introduction

One of the most important measure of success for the Go-Lab project – and in fact for any project - is heavily dependent on how well it addresses its intended user's needs and how effective it engages its end-users in its activities. Go-lab had been designed from the very beginning to offer teachers and schools the opportunity to learn about an innovative and effective methodology to teach science, by engaging them in a various training and community activities.

The goal of these activities – especially of WP6 and WP7 – was to enable educators not only to apply an effective pedagogical model and using an advanced technological structure, but to help and support them in creating new content, design engaging lessons and implement and pilot them in their classroom or in extra-curricular activities. This, however, can only succeed if the project is able to involve a large community of practice that implements not only the proposed scenarios, but creates new Inquiry Learning Spaces (ILS) and motivates and trains their peers and colleagues in the use of the developed materials.

In order to achieve this goal and to safeguard a successful piloting under WP7, the activities of Go-lab had to encompass a strong professional development component and the support to the creation of a strong, active and collaborative community. The approach developed under WP6 was offering 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. During the past years, teachers were trained on how to address curriculum content by using the inquiry based learning methodology, by using online virtual and remote labs, and by motivating students to reproduce scientific discoveries and/or produce their own new experiments.

This deliverable is therefore a joint final report of WPs 6 and 7. Overall, the aim of this report is to summarise the concept, methodology and activities of the community support activities, and demonstrate its effects on the uptake, use and implementation of the Go-Lab system. Furthermore, it analyses the results of the pilot activities carried out under WP7 and how the Go-Lab system was used by teachers in classrooms and other educational settings. It should be considered as a continuation of (Mavromanolakis, 2015a) and (Mavromanolakis, 2015b), "Report on Implementation Activities Phase-A" and "Phase-B" respectively and reports of WP6 (Fasoulis, 2014) and (Doran & Sotiriou, 2015), "Report on Participatory Engagement Activities, Phase A" and "Go-Lab Report on Development of the Virtual Go-Lab User Community-V1" respectively. The document summarises first the methodological framework of the community building in Chapter 2. Then continues in Chapters 3 with the description of the results of the support and engagement activities. Chapter 4 aims to demonstrates the effects of the community building activities on the Go-Lab system use. Finally, Chapter 5 presents and analyses the pilot implementation activities in schools.

The data analysed in the following sections is used from the following sources:

a) Google Analytics from the Go-Labz and Graasp websites;
b) The Graasp summative user data as provided by EPFL;
c) The full raw user data of the Graasp system;
d) Two surveys conducted in the last months of the project.

The raw user data of the Graasp platform was analysed and filtered specifically for the analysis of the school implementation as presented in Chapter 5. The data allowed for a detailed filtering, e.g. for the exact time of usage and implementation of the pilot schools.

For the one survey, pilot teachers were invited to participate in an online survey, called the “Go-Lab Summative Questionnaire”. This survey was designed to complement the findings from the last phase of engagement activities, the summative events. In total received 203 replies were received. The main aim of the survey was to collect an overall view of the perception of pilot teachers while interacting with the system: how they used Go-Lab, how the system supported their teaching practice, how user friendly was their experience while using the portal and the authoring tool; the main barriers encountered and finally open the floor to receive suggestions for improvement. Main findings can be found in chapter 3 of this deliverable and the full report in (Mavromanolakis & Doran, 2016).

Another online survey was designed to support the main conclusions related to the impact of our community support framework. The target audience for this questionnaire were the teachers that participated in the summer schools and the pilots trained in Portugal. The main aim was to inquiry participants about the validity and impact of the various support activities and support tools made available by the project. The summary of responses is being presented in Chapter 4.3 of this deliverable and full report in (Mavromanolakis & Doran, 2016).

2. The Methodological Framework for Teachers' Professional Development through Community Building

2.1. Community Building as Professional Development Activity

The whole concept of the Go-Lab community building and training activities is based on the following understanding: Teachers are the key in the implementation of innovations in school classrooms. But especially using the inquiry-based learning model and using online labs for example poses complex challenges for the teacher (Airasian, , Engemann, & Gallagher, 2007), (Krajcik, Blumenfeld, Marx, & Soloway, 2000). In Inquiry Based Science Education (IBSE) the teacher needs to become the coach of students – to provide scaffolding for the inquiry and sense-making process, and reduce confusion by modelling practices, providing feedback and helping students plan and perform investigations.

In order for teachers to fully realize the potential of the teaching in IBSE, it was necessary to provide them with the necessary training and support mechanism that would create the conditions for teachers to undertake this new, challenging role of the proposed approach adequately and assist them in every step of the process (Falik, Eylon & Rosenfeld, 2008).
In Go-Lab specifically there were three key points that we understood to be crucial for the successful application of ILS in educational settings:

- **Providing effective training on inquiry based methods and on the use of online labs:** Albeit very effective for student learning, inquiry-based methods in science education constitute a major paradigm shift for teachers: they need to acquire new skills, abandon long standing practices and move away from their professional “comfort zone”, therefore exposing themselves to perceived, or real, risks;
- **Assisting behavioural change:** Apart from their training, in order for teachers to introduce both inquiry based methods and online labs into their everyday routine, they need to perform a change in behaviour and adapt a new culture and philosophy. In order for the Go-Lab approach to assist this change, we were introducing a solid theoretical framework and underline the main actions that need to be taken;

Supporting localisation and adaptation: Helping teacher to localise the content provided and developed in Go-Lab and to make it fit to the specific needs of each teacher and the students has proven to be an important point during the large scale implementation. In order for the same ILSs to be used in different countries and/or school settings, the diverse curricular expectations and needs as well as the special characteristics of each classroom made it indispensable to help and support teachers to adjust the Inquiry Learning Space (ILS) to their own specificities (e.g., local language, metric system, different subject area of each school or group of students). Go-Lab is very powerful in terms of allowing easy ways to adapt the existing material to address these issues.

2.2. The Importance of the Go-Lab Community building for the Large Scale Implementation

Go-Lab provided a great opportunity for the professional development of teachers. It brought together cutting edge tools and resources for science education, a rich collaborative environment and a strong component of community support coming from national coordinators. However, the current situation of schools in many of the countries of the consortium is still not supporting the full implementation and integration of the Go-Lab services. As is in (Doran & Sotiriou, 2015) there are severe constrains that educators face, most prominently:

- **Time:** Too little time to explore new tools and new trends;
- **Curricula:** Too dense and extensive curricula that doesn't allow experiments;
- **Exams:** Too much continuous pressure to prepare students for final exams;
- **ICT:** Lack of ICT infrastructure and support;
- **School:** Lack of school support.

The Go-Lab Community Building Activities had to take these major restrictions into account and design and develop a sustainable support framework that would allow to support teachers despite their limited resources to learn about, create and implement Inquiry Learning Spaces in their schools as part of the large scale pilot activities under WP7. More specifically, during the implementation phase of Go-Lab, teachers had the opportunity to acquire important key skills through workshops and training to became eventually creators of their own highly interesting ILSs. Many ILSs are easily adaptable to all types of mobile devices, targeting curriculum content and are designed to be fit the classroom time duration. To a certain extent, these examples promoted a more in-depth learning on students participating in the lessons. In some cases, teachers reported that students required less time in order to learn specific content when presented and addressed with an ILSs. However, it should be noted that the implementation in the majority of the cases are not yet mature enough to ensure a proper evaluation of the (long-term) impact in their performance when exposed to national exams; further studies would be required. School support can be expected to increase wherever Go-Lab has successfully been introduced and success stories and positive teacher and student feedback have been received in the pilot schools.

It was clear that any support framework cannot fully rely on only one type of support activity alone, but has to simultaneously address various approaches and offer different solutions to reach and help as many teachers in as many countries as possible. In theory, the following all-encompassing framework was designed and developed to answer to the needs and challenges that could offer the best solutions between the possibilities available.

Table 2.1 The 5 pillars of the Go-Lab community building framework.

Engagement	Training	Support	Recognition	Community
Visionary Workshops	**Face-2-face training**	**Online Support**	**Certification and Accreditation**	**Teacher's Communities**
Practice Reflection/ Summative Workshops (face-2-face and online)	**Online Training (MOOCs, / Webinars, etc..)**	**Demo Activities in School**	**Contests**	**Teacher's Mailing list**
Pilot Days (teacher's gathering days)	**International /National schools**	**Teacher's Helpdesk** (support page, tutoring page, etc)	**Digital Badges**	**Teacher's Cascade** (Teachers Training Teachers **)**
	Pilot's cascade (teachers training other teachers)		**Best Practices** (Teachers's and students' highlights, success stories, etc)	**International / teacher's gathering events**

In Table 2.1 we present the 5 pillars of the Go-Lab support framework that altogether represent the Community Support mechanism created to ensure the continuation and sustainability of Go-Lab**:**

- **Engagement Activities**: These activities provide a series of opportunities to directly engage schools and teachers on the use of Go-Lab and IBSE. The main objective of this first pillar is to create awareness about the existence of the project, to reflect with and to learn from main users on the usability of the overall structures and the system, to support the adaptation/localisation efforts in their specific settings and to provide a sense of ownership and partnership to those teachers that are using and piloting Go-Lab in their classrooms. These engagement activities have been perpetuated by the Go-Lab experts, teachers that are now skilled on the use of the system and are now catalysers of newcomers and promoters of new opportunities for the growth of their own local communities;
- **Training Activities**: The community of users is composed by those that are making use of the system and integrating them in their daily teaching. Training events are a core activity and ensure that teachers have the opportunity to explore the whole system and benefit from immediate support coming from the Go-Lab team and/or from pilot teachers already proficient on the use of the project proposed methods and tools. The training events are opportunities to explore the system, the method, and the already existing content;
- **Support Activities**: A strong help desk that provides teachers with the necessary ongoing support to answer their immediate questions or is available to support the piloting implementation efforts in the classroom or other educational settings is the heart of the sustainability of Go-Lab. To this end, a series of actions to create a

support hub and a peer-to-peer support platform have been implemented with various degrees of success. Demo activities and pilot days (pilot teachers' gathering days) have been implemented to ensure the adaptation of specific needs and the active collaboration of all stakeholders in the field. In demo activities Go-Lab is presented to the school community by involving students and teachers in the use of the system, it is used as a tool further support pilot teachers and to engage others in their local community. The pilot days are devoted to teachers, newcomers or experienced ones, with the main purpose to explore specific features and/or content of existing ILSs, labs and apps; to discuss shortcomings and share success stories;

- **Recognition Activities:** For many teachers, certification and accreditation are an integral part of their professional development. With this vision in mind, Go-Lab has investigated how to develop an efficient recognition mechanism that validates the participation of all teachers and eventually recognize their support according to the different levels of commitment. While some actions (such as the digital badges and official accreditation) need more time to be fully developed and applied, other actions (such as the international contests and the promotion of the winners) were able to immediately provide the recognition to teachers and their efforts in the creation of innovative ILSs;
- **Community Activities**: The size of the community and its level of engagement are the good indicators of the future potential success of the sustainability of the Go-Lab Community. The necessary mechanisms to support the creation and continuation of the community are the key aspects of this pillar. This pillar is where teachers take the stand and the cascade effect starts to take over the process ensuring the continuation of efforts placed in the pillars before.

The framework embeds the heart of the support necessary to help teachers overcome their main constrains.

In section 4 we present a few indicators that are supporting this framework and encouraging us to keep investing in the framework as a sustainable model for the perpetuation of the project.

3. The Go-Lab Community Building Activities

3.1. Engagement Activities

3.1.1. Engagement Activities

For the last year and final implementation phase (October 2015 – July 2016) of Go-Lab the engagement activities aimed to reflect in direct collaboration with Go-Lab pilots' community, i.e. the teachers that used the system for its full extent. This was done in order to learn about crucial aspects of implementation and piloting, such as the usability of Go-Lab in the teachers' specific settings, the effectiveness of the developed support infrastructure and the potential of the future uptake of the Go-Lab system, and to generally understand their experience in dealing and using Go-Lab. Overall, during the full duration of the project of 4 years, 99 engagement activities were organised, directly involving more than 1.200 teachers (please see also deliverables, (Fasoulis, 2014), (Doran & Sotiriou, 2015) and this deliverable).

Over the past 12 months, a total of 17 summative workshops were promoted, involving 191 teachers and other stakeholders, that have used the system and participated in Go-Lab activities over a prolonged period of time. The main objective was to invite those teachers that have regularly and repeatedly used the system, in order to reflect together with them on their experiences, spot the best practices, review the path taken, share lessons learned and help us refine the legacy of Go-Lab. The complete reports can be found in (Mavromanolakis & Doran, 2016) (annex to this deliverable). In this document we summarise the main outcomes for each of the Go-Lab countries.

During the summative events the experiences of the participants with Go-Lab were shared and registered, and teachers were encouraged and invited to reflect on the possibility of continuing using Go-Lab after the end of the project. It also served the purpose to understand if the existing support mechanism (or which part of it) would be sufficient to safeguard the continuation of usage of the platform. Teachers shared in those events their overall experience with the use of the Go-Lab websites and platforms, their usage of the existing support mechanisms, the influence that Go-Lab had on their individual professional development, the perceived changes of students' attitude towards science learning and finally the influence of the overall experience within their schools, towards their colleagues and the school curriculum. Discussions related to the challenges and barriers encountered were also stimulated.

Table 3.1 Engagement activities promoted by national coordinators

Country	Summative Workshops (SW)	Teachers
Austria	2	2
Belgium, Italy and Poland	1	31
Cyprus	1	7
Estonia	1	16
Germany	5	5
Greece, Romania and Bulgaria	3	36
Netherlands	1	42
Portugal	1	30
Spain	2	22
TOTAL	**17**	**191**

3.1.1.1 Austria

Training in Austria was mostly performed online and teachers who participated could after the initial training produce their own ILS and implement it in the framework of the curricula. Their view is that Go-Lab promoted deeper understanding of different concepts and students are motivated students more than traditional lectures. Teachers are also motivated to use IBSE and find it a very good method to improve student learning outcomes. One of the participants is also willing to become a Go-Lab ambassador and engage other teachers in his school. Challenges faced by the teachers were related to lack of experience with some of the apps.

3.1.1.2 Belgium, Italy, and Poland

Three workshops were promoted involving participants from the 3 countries. Two of the workshops were practice reflection events and the last one a summative event. The online events were a very good trigger for discussions and exchange of information between the participants. Fruitful discussions were promoted related to their experience with Go-Lab, the usefulness of Go-Lab in their teaching, the impact of Go-Lab in their teaching, the students' reactions, the cross curricula activities, the challenges for the Go-Lab system, the recommendations, necessary pedagogical changes and improvements for Go-Lab to be more advantageous in the teaching practice. Teachers participating in the PRW had little experience with Go-Lab but they were very positive due to the high impact it had in students. Need for translation was a recurrent topic. Demo activities were named as imperative in order to engage other colleagues in using Go-Lab. Participants mentioned that the existence of online training and webinars were key to the uptake as it allows for flexibility in time schedules. Teachers participating in the SW had a diverse approach (classroom implementation vs. motivational tool students and for homework activities) towards their use of Go-Lab which greatly enriched the discussions. They agreed that Go-Lab had a positive impact in their teaching. As in other countries the positive impact on students was highlighted. As recommendations they named: further training, translation of resources and improvement of learning analytics tools.

3.1.1.3 Cyprus

The Go-Lab teacher community in Cyprus was relatively small and thus, the communication between them and the national coordinators was mainly done through personal meetings (trainings, seminars etc.) and email exchanges. Teachers selected to participate in the online SW were selected among those who were actively using Go-Lab in the last phase of the project. Participants highlighted the importance of the support received from their schools. The most impactful comments were again related to students and how their experience and learning was satisfactory. They appreciated the possibility of providing personalized feedback to students at any time. Participation in research projects can be a challenge to teachers as well as the support coming from other colleagues. The possibility to share their ILSs publicly was highlighted as an important tool to make the project known and used in all the country. The possibility of using Go-Lab as a tool for homework assignments was also appreciated. Lack of computers and internet access was considered a challenge. Inquiry is not the common methodology used but teachers can used it, which means that Go-Lab was a very good motivation for them to start training on the use of this methodology.

3.1.1.4 Estonia

A very positive attitude is coming from teachers in Estonia as they are sharing their Go-Lab experience and created ILSs with other colleagues. Teachers in general are worried with finding suitable correlation between online labs and the curricula, on how to support inquiry skills in their students and improving their own digital skills. Teachers highlighted the possibility of participating in Go-Lab summer schools for the opportunity to enhance their ICT and inquiry related skills and also for having the opportunity for collaboration and exchange of ideas with other teachers. They consider Go-Lab suitable to be applied within their curricula and good for improving student’s inquiry skills. But some training is still necessary in Estonia as the majority of the pilots used the labs and already existing ILSs due to finding challenging the creation of an ILS themselves. They find the Go-Lab portal’s structure very user friendly and highlighted the existence of such a variety of labs in only one place. Major challenges were related to internet access, language issues and time constrain to prepare their lessons.

3.1.1.5 Germany

One of the teachers reported preferring to create his own tailored ILSs in order to better address his student’s needs. His students are highly motivated by using the ILSs for the freedom it provides. They follow the lesson in their own pace as opposed to listening to a traditional class where the teachers are taking the stage. His only suggestion is to have more ILSs in German. Another teacher values the possibility of using experiments that couldn’t possibly be brought live to the classroom. This teacher tried to engage his colleagues in the use of Go-Lab but the existence of a learning platform in school made things a bit more difficult. Again the main suggestion was to have more material in German. The Big Ideas were also referred as a good guideline for the students supporting their learning. The fact that Go-Lab allows students to progress at their own pace was mentioned several times. Better explanation on how to use the labs would be appreciated. It was also referred the possibility to integrate an ILS within the regular didactical hours as a plus.

3.1.1.6 Greece, Bulgaria, and Romania

During the SW in Greece, participants discussed several themes concerning Go-Lab initiative and approach, the use of IBSE, the science curriculum reforms necessary among other topics. A general remark was the need for more flexible curriculum allowing for more freedom to choose how and what to teach. The time constrains was also discussed and how this can pose a severe challenge for the implementation of Go-Lab. In general, they consider the use of Go-Lab were the IBSE methodology is embedded is good in order to engage students and to sparkle their motivation. Some complaints emerged related to the difficulty to understand the use of some labs and apps. Some of the teachers referred that they still prefer hands-on activities. They found the existing online lessons and educational resources useful but difficult to implement in real school environments due to lack of appropriate ICT infrastructure. In general, the use of the IBSE methodology was considered very important and useful.

For Bulgarian participants the SW was conducted online and the participants were representing groups from different parts of the country. They highlighted the importance of Go-Lab for their professional development and how greatly the project will contribute to the modernization of teaching and learning in their schools. They found challenges related to resistance on the part of students and colleagues to uptake the methodology proposed by Go-Lab. Once this resistance is overcome the results were outstanding. They truly appreciated the variety of online labs offered in one common place. Their main recommendation was to keep the training events alive, to foster the production of more material in Bulgarian.

Teachers from Romania really appreciated Go-Lab but referred the need for much more training. They also highlighted the need for materials in Romania and tailored for the classrooms didactical timings. The participants were all very excited with the possibility of continuing using Go-Lab and the potential the tool presents to improve their lessons. They are in general eager to build collaborative scenarios and engage colleagues and even teachers from other schools. Strong support from their headmasters was a common reference. The reaction of their students to the use of ILSs was reported as highly motivated and hoping that all the lessons would be in the same format. The existence of many labs was referred as unique but the lack of ICT infrastructure in the country was referred as a major impediment.

3.1.1.7 The Netherlands

Two visionary workshops were conducted, the first one with a group of teachers and the second one with a group of teacher trainers. The portal was introduced to the participants and then a hands-on session where the participants had the opportunity to design an ILS using specific labs as inspiration. Participants were enthusiastic about the use of virtual labs but their designs made it clear that some training on the use of the IBSE methodology was necessary. In the session with teacher trainers, special emphasis was put to understand how Go-Lab could be implemented in classroom and what were the specific needs to take into consideration.

A summative event was conducted with a group of Go-Lab users. They were all very enthusiastic about the continuation of using Go-Lab. Teachers reported on their own practice and a few specific themes were discussed: the lack of confidence of students in using Go-Lab, the need for translation, and the need for support in their local schools. The general impact on students was positive. The need for further training was also clear in particular with the newly introduced changes to the curriculum. Time constraint was a common concern.

3.1.1.8 Portugal

The summative workshop in Portugal had components of reflection, sharing of good practices and success stories and ended with a simulation of a possible integration of the project in the new changes being put in place by the new Ministry of Education. Go-Lab was reported as a very good opportunity for their professional development in terms of use of technology and to get proficient in the IBSE methodology. Time constraints and exam driven schools are still main concerns of the teachers. There was a discussion about the integration of Go-Lab in the future classroom lab, a model that is being adopted by many schools in Portugal. In general, the attitude of students ranged from excitement with the innovative process to feeling lost with the newly acquired freedom. ICT structure and support remains a big challenge. Many participants became ambassadors and are willing to continue using Go-Lab in the future.

3.1.1.9 Spain

During the summative events the new features of Go-Lab were presented. To the participants the highlight of Go-Lab was the effect on students. They enjoyed being responsible for a scientific experience, although some of them felt uneasy with the new model. Learning analytics tools were not generally applied and used, but some discussion around that took place. They appreciated the integration of IBSE in Go-Lab stating that it helped them structure their lesson in the proper direction. They expect that the platform will be kept running as they plan to continue using Go-lab. Teachers used Go-Lab with different approaches. In one instance it was used as a tool to promote collaborative projects, other used to promote international courses. Teachers mentioned that the fact that they had the virtual labs available introduced an important degree of freedom as they could have more time to explore different experiments. They felt that Graasp was a powerful tool to help design innovative and creative lessons. Teachers feel it is important to have recognition of their work. Teachers left a recommendation that more information related to the existing ILSs, apps, and labs are provided when searching the portal.

3.1.2. Online Survey

Pilot teachers were invited to answer an online survey aiming to collect important input related to their experience with Go-Lab. We had 203 participants to the survey coming from partner's countries.

Table 3.2 Number of participants of the online survey per country

Country	Number of Valid Answers
Austria	2
Belgium	6
Bulgaria	7
Croatia	3
Cyprus	12
Estonia	14
Germany	7
Greece	40
Italy	13
Netherlands	10
Poland	6
Portugal	24
Romania	24
Spain	24
Switzerland	1
United Kingdom	4
Other (International Group)	6
Total	**203**

Generally, participants are very positive towards the use of Go-Lab. Figure 3.1 clearly shows that they consider it as a good tool that supports their teaching. When compared with the previous pilot phase questionnaire, a shift towards a better agreement with this statement can be seen (see results presented in Doran & Sotiriou 2015). Furthermore, a considerable number of teachers introduced Go-Lab in more than one lesson as can be seen in Figure 3.2., also trending towards a larger use than what was responded in previous survey as can be seen in (Doran & Sotiriou, 2015) .

Not at all: 1
2
3
4
5
6
A lot: 7

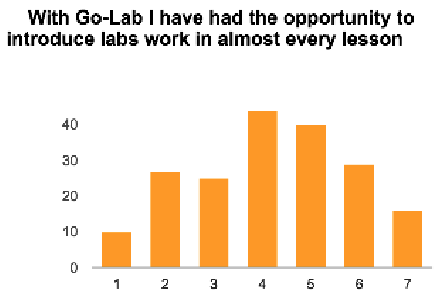


Figure 3.1. Go-Lab as a supporting tool to teaching.

Figure 3.2. Usage of Go-Lab in classroom.

Figure 3.3 shows that one of the most frequently reported barriers encountered by the teachers is the insufficient ICT infrastructure; a problem that clearly couldn't be addressed at project level. But the lack of ICT literacy as a barrier has decreased, compared with the data of last year's deliverable (Doran & Sotiriou, 2015). However, this has also to do with the sample of teachers that chose to participate in the survey. These are the teachers that participated in the whole process and thus had the opportunity to be part of the training events promoted by the consortium.

The curriculum compatibility of the existing published ILSs continues to be an issue but this has a tendency towards improvement as more ILSs are now being published. The lack of support coming from the school remains high and there again there is not much that we can do.

Curriculum compatibility – The proposed activities are not part of the curriculum	**85**	41.7%
Lack of ICT tools in classroom – There are no computers for every student	**128**	62.7%
Lack of teachers' ICT literacy – Too demanding for me	**27**	13.2%
Lack of support from school	**48**	23.5%
Other	**27**	13.2%

Figure 3.3. Main barriers.

Participants who have not publish their ILSs, (59.3% of responders) reported mainly the following reasons for not doing so: Lack of time and lack of adequate knowledge of the system to ensure quality of the ILS. In some of the reflection events it became clear that teachers fear being evaluated by their work and are not confident enough to make their scenarios publicly available.

Over 95% of the participants of the survey stated that they will continue using Go-Lab in various ways: in addition to their lessons, as support for their teaching, in science research projects, as a complement to experiments with real materials, to continue developing the inquiry skills of the students, as homework for students.

Go-Lab helped to improve the proficiency of 70% of teachers in the use of applying an Inquiry based learning (IBL) methodology. This was achieved via the training events, the use of already existing ILSs, and the support provided by the project. Besides this IBSE competence, 52% of the teachers reported that Go-Lab helped them improve their ICT skills.

Asked about preferred improvement to the system, the most common suggestions were related to language issues, the need for more published ILSs - in particular those addressing curricula content -, to have provisions for slow internet connections, to add more labs, include more resources for primary schools, and better descriptions of labs and apps.

The least appreciated aspect was the required time to create an ILS and the necessary time to properly implement and inquiry scenario.

Concerning their favourite features, participants named the repository of labs and apps, the support, the user friendly way of sharing an ILS with students, the possibility of creating multidisciplinary scenarios, the user friendly way to introduce inquiry, and provide interactive and collaborative experiences to students while being users and for teachers as creators of new content.

3.1.3. Coordinator Newsletter

From July 2015 to the present date Go-Lab started a new communication initiative. We have established a direct communication channel between the coordinator of the project with the pilot teachers. The idea was to keep them informed about the progress and news related to the project provided directly by the coordinator. The main aim was to acknowledge pilot teachers as an important part of the project as indeed they are. In total 7 newsletters have been sent.

Table 3.3 Recipients and views of newsletters

Date	Number of recipients	Number of Views	%
03/07/2015	1072	577	55.6
10/09/2015	1244	533	44.5
23/11/2015	1621	819	52.2
17/12/2015	1619	740	47.2
14/03/2016	1621	569	36.4
21/06/2016	2050	867	43
03/10/2016	2035	889	44.5

The impact on the community was very relevant. In many of the face-to-face events the newsletter was a topic for discussion. Teachers manifested their appreciation of this direct channel of communication with the coordinator, that strengthened their understanding of being part of the Go-Lab project as well.

3.2. Training Activities

3.2.1. Training workshops

Before and during the implementation phases of the project the national coordinators and partners offered and conducted comprehensive training for teachers covering the pedagogical and technical aspects of the Go-Lab approach and system. A series of introductory and support activities, such as introductory presentation/demonstration seminars and follow-up training workshops were organised, in order for the teachers to get familiarized with the pedagogical approach and methodology, to practice the relevant technology and platform, to gain confidence in actually implementing what they learned and finally be able to independently adopt and adapt the use of online labs in their everyday school practice.

Figure 3.2 Highlights from a typical series of training workshops offered.

The training workshops followed a staged approach in order to accommodate the needs of both experienced and inexperienced teachers. At the first stage usually general introduction and preliminary teacher training workshops were organized at local or national level. The agenda of which typically included topics such as: what is inquiry and inquiry-based science education; what is an online lab; what is Go-Lab approach and what it offers; what is an inquiry learning space, etc. Follow-up hands-on workshops were scheduled and conducted soon after and if possible for groups of teachers according to teaching subject or experience or school level. During these workshops, more focused and practical trainings were offered. These included hands-on practice on the available portal of resources, online labs, supportive apps, and the authoring platform. Teachers also collaboratively explored opportunities of use within their standard science curriculum. They also learned and practiced to adopt and use a ready-made ILS or start creating a new one. In most cases the training workshops for teachers were also organized in collaboration with local educational authorities, school counsellors, or other stakeholders in order to achieve better dissemination and promotion of the project’s objectives, approach and offered services. At the final stage there were the actual implementations of inquiry educational activities with students at schools. These activities were organised in collaboration with partners or actually conducted by project members as a means of supporting teachers to acquire further confidence and practical experience. Figures 3.1 and 3.2 depict graphically the aforementioned main stages of a typical series of training workshops offered to teachers.

Figure 3.3 Typical training topics and highlights of training workshops.

For the Go-Lab pilot phases A and B in the national coordinators and partners organized a plethora of training workshops following the scheme described above. During the first two implementation phases, 1174 teachers from 684 schools were trained. They continued the effort during the third and final implementation Phase C adding another 518 teacher participants from 357 schools. The total results after Phase A, B, and C are: 1692 teachers from 1041 schools attended the training workshops that partners organised.

Table 3.4. Total number of teachers and schools in trainings activities.

	Phase-A	Phase-B	Phase-C	Total
Teachers participated in Go-Lab Trainings	380	794	518	1692
Schools participated in Go-Lab Trainings	344	340	357	1041

A more detailed breakdown – also per country – of the number of teachers, students and schools that participated in implementation activities or in Phases A, B and C, are comprehensively presented and discussed below (see chapter 5). This is in order to keep consistency with previous deliverables (Mavromanolakis, 2015a); (Mavromanolakis, 2015b) and for completeness so that the reader can better compare them with the results from the analysis of the system data presented therein. The full list of activities is also shown in Table 2.1 of Annex II of the joint deliverable (Mavromanolakis & Doran, 2016), which tabulates the main details of each event/activity, namely: country, partners involved, dates, type of activity, participant teachers or students, online labs practiced and subject domains. Annex II also contains all the reports wherein partners documented each activity.

3.2.2. Go-Lab Summer School 2016

The final summer school of the project took place once more in Marathon (Greece) from 03 to 08 of July 2016. In total, 40 participants from 20 European countries were attending the course, out of which 30 participants were invited as winners of the contest organised in the months before. Four Go-Lab partners supported the training activities during the whole week. The main aim of the summer school was to improve the participants' proficiency in the use of IBSE concept, promote the use and creation of more labs, and enhance their ILSs with more and new apps. But the most important objective was to promote the construction of collaborative ILSs. Teachers worked in international interdisciplinary groups and in the end had the opportunity to share their scenarios with the rest of the team. The material produced during the summer school presented a high quality and teachers were very enthusiastic about implementing it with their students in the new school year.

Teachers had the opportunity to participate in many social and cultural activities and exchange experiences and ideas with other teachers participating in parallel events. A full report can be found in (Mavromanolakis & Doran, 2016).

Table 3.5. Total number of participants in Go-Lab summer schools.

Country	Nº of participants 2014	Nº of participants 2015	Nº of participants 2016
Austria	3		
Belgium	1	1	1
Bulgaria	1	1	3
Croatia	1	1	2
Cyprus	2	2	1
Estonia	2	2	2
Finland			1
France			1
Georgia			4
Germany	2	2	1
Greece	6	2	2
Hungary		1	
Italy	2	2	1
Latvia			1
Poland	1	1	4
Portugal	5	7	3
Romania	3	2	3
Serbia			1
Slovenia	2		

Country	Nº of participants 2014	Nº of participants 2015	Nº of participants 2016
Spain	7	3	6
Switzerland	1		1
Turkey			1
The Netherlands		1	
UK			1
Total	39	28	40

3.2.3. MOOC

An online training course was developed in the format of a MOOC. The course was divided into 6 modules that covered topics ranging from the introduction to the inquiry methodology, the creation of ILSs to the use of specific labs and exploration of targeted science topics. The course was repeated 3 times and reached over 560 participants. Over 70% of the participants were STEM teachers and the majority were new to Go-Lab and 91% of responders to the evaluation questionnaire found the course good or very good. A full report on the MOOCs can be found in (Dikke 2016).

3.3. Support Activities

3.3.1. Tutoring Platform

The structure and functions of the tutoring platform have been described in detail in the previous version of this deliverable (Doran & Sotiriou, 2015). For this report, we would like to briefly present the current user statistics of the official Go-Lab online support area and community area of the Go-Lab portal.

The tutoring platform is for sure an important element for a sustainable future of the project. Many of the Go-Lab ambassadors are now tutors in the tutoring platform ensuring the continuation of the support to the newcomers. There are in total 90 tutors ready to provide help and support.

During the last piloting phase of the project over the past 12 months, the tutoring platform had 350 active users. More than half (185) were new users looking for support. Information retrieved from Google analytics show an evolution in the user numbers of the tutoring platform. While in year 3 of Go-Lab 1.959 sessions were recorded, in year 4 a total of 3.873 session were counted.

The overall number of users increased from 861 users to 1.823 users, while the page views recorded in a significant increase from 12.531 page views at the end of year 2 to 19.905 at the end of year 4.

A total of 15 webinars are available in the platform with topics in different languages.

3.3.2. Forum

During the 4 years of Go-Lab, the project worked on all levels and sections to create an open, web-based community interested in the project's outcomes and continuous developments. One aspect to facilitate the creation and sustainability of this community, was the developed a forum integrated into the Go-Lab portal. This forum, together with the Facebook group and Twitter account, were common places for teachers to share best practices or questions with other teachers around Europe and beyond. The forum reached from January to September 2016 7.165 page views.

In order to support the use of the forum a series an action plan was set in motion and several new threads were initiated in the forum: news, technical support, pedagogical support, the Go-Lab competition and resources of the month.

Several strategies were also put in place in order to keep and boost more interest to the forum: online introductory courses, using twitter to engage teachers, promote a thread for teachers interested in participating in the workshop that took place in Brussels in May/2016.

The last mentioned thread successfully engaged almost 50 teachers to share their work with Go-Lab in the forum. Some really inspiring stories can be found there (http://tutoring.golabz.eu/forum/events/%E2%80%9Cstem-discovery-week-innovative-practices-inquiry-based-learning%E2%80%9D-future-classroom-lab). Here we highlight a comment from a Polish student:

"Before I took part in this exercise, the scientists had seemed to me as a closed group available only to selected, talented and brilliant individuals. Understanding the simple methods of research, I have realized how exciting, beautiful and simple can be to learn the truth about the world around us."

The following two teachers are specifics examples on how these individuals have been part of this community.

Costantina Cossu (http://tutoring.golabz.eu/profile/1503) is a science teacher for Secondary education in Alghero, Italy. She was the speaker of one of our Italian introductory workshops we run in January 2016. Costantina has been active on the forum and in social media sharing some of the tweets and engaging other Go-Lab teachers in an open dialogue about their work.

Tsetsa Hristova (http://tutoring.golabz.eu/profile/995) has been an active Bulgarian teacher who is experienced in European projects on STEM education. She has created several Inquiry Spaces together with other teachers, like "Solar Structure (SHM)" (http://www.golabz.eu/spaces/solar-structure-shm). She has started threads in the forum and has shared with the community her experience using ILSs as it can be seen in her posts "Astronomy" (http://bit.ly/2d3zcd4) and "Renewable energy" (http://bit.ly/2cIOYud). She also participated and was selected to attend the Go-Lab workshop organised in the Future Classroom Lab, Brussels, in June.

The full report on the forum can be found in (Mavromanolakis & Doran, 2016).

3.3.3. Support Page

The support page was already described in (Doran & Sotiriou 2015). During the last year of Go-Lab the important developments were the translation of the support manual and scenario handbook to several languages: Bulgarian, Estonian, Dutch, Portuguese, Greek, German, Romanian, Spanish, Basque, Catalan and Turkish.

In addition to these a series of videos and tutorials were created and can be divided into two categories: videos about the Go-Lab apps and videos about authoring an ILS. The main aim was to create short videos addressing key topics of the platform. Table 3.4 presents a list of the created videos.

Table 3.6. Eight guidelines for the design of instructional videos.

Guideline 1: Provide easy access
Craft titles carefully, avoiding jargon
Guideline 2: Use animation with narration
2.1 Be faithful to the actual interface in the animation
2.2. Use a spoken human voice for the narration
2.3 Use a conversational style
2.4 Action and voice must be in synch
Guideline 3: Eanble functional interactivity
3.1 Pace the video carefully
3.2 Enable user control
Guideline 4: Preview the task
4.1 Sell the goal
4.2 Introduce new content by showing its use in context
Guideline 5: Concentrate on giving procedural information
5.1 Include deliberate pauses to stimulate reflection
Guideline 6: Make tasks clear and simple
6.1 Follow the user’s mental plan in describing an action sequence
6.2 Emphasize the interconnection of user actions and system reactions
6.3 Use singnaling techniques to guide attention
Guideline 7: Keep videos short
Guideline 8: Strengthen demonstration with practice

In additions to these videos made, teachers were asked to make videos of their own. The idea was that teachers can inspire other teachers in the use of Go-Lab, which will help foster a sense of community among the Go-Lab teachers. Teachers have experience with learning to navigate the portal and the authoring environment Graasp and as such know exactly the challenges others will face. These videos are in the native language of the teachers and accompanied with English subtitles. The teacher are in the picture during the entire or during part the videos, making it more personal. These videos do not follow the strict guidelines above and vary from one teacher to the next. They highlight the unique perspective of each teacher and the way they use Go-Lab in their classroom.

All tutoring videos can be found at http://www.golabz.eu/videos. A complete list of all available videos can be found at the right side of the screen. It is also possible to use the search bar at the top of the screen to search for video tutorials. The videos about the Go-Lab apps are also presented on the app pages in the portal. If you enter the portal an select a specific app, the video can be found at the bottom of the page.

3.4. Recognition Activities

3.4.1. Contest

The Go-Lab contest “Promoting Multidisciplinary science teaching” was launched in order to further disseminate the Go-Lab project and to increase teachers’ participation in the Go-Lab activities. The contest was launched on November 11th 2015 and the submission period ended on May 31st 2016. Teachers were asked to demonstrate how they used Go-Lab in their classroom. More specifically, the entries that were going to be submitted by the contestants had to follow three rules:

- Implement an activity with a class of students between 10 and 18 years old in order to demonstrate to them the connection between two or more concepts or phenomena they learn about in different science classes. The activity can be either a Go-Lab activity or the Go-Lab "Big Ideas of Science" challenge;
- Record the implementation process as well as students’ results and present them in the form of a report, or by making a video, a presentation or a poster;
- Submit their presentation to the contest by April 30th 2016.

The contest targeted teachers from all countries participating in the Go-Lab pilot phases. The teachers with the two winning entries from each country would be invited to attend the Go-Lab Summer School in Marathon, Greece between the 3rd and 8th of July 2016. Overall 65 teachers registered to the contest and 30 were selected to be invited and attend the Summer School.

3.4.2. Badges

Open Badges are now becoming a very popular way to recognize specific competences of teachers. We see very frequently in social media teachers sharing their acquired badges and in some institutions it is being accepted as part of the curriculum vitae of their collaborators. Go-Lab decided to text this strategy and will award badges to teachers. Badges were created according to the categories defined in Table 4.2 and will be distributed to a few teachers in order to pilot test their reaction.

Table 3.7. Go-Lab badges per category.

	Assigned to those teachers that became acquainted with the Go-Lab Portal and have successfully integrated online labs in their lessons.
	Assigned to teachers that have adopted and/or adapted an ILSs.
	Assigned to teacher that have developed their own ILS.
	Assigned to teachers that have successfully implemented ILSs with their students.
	Assigned to teachers that have successfully trained other teacher on the use of Go-Lab tools and methodologies.

3.5. Community Activities

The success of Go-Lab is very can be measured in many different ways. The quality of the technology associated to it, the support provided to users and the uptake of the Go-Lab proposal and methodology by teachers and schools involved in the project. But the main aim a project built to address teachers' and students' needs is certainly having a good impact and acceptance by the school community and education authorities.

3.5.1. Teachers training teachers – best practices

The sustainability of Go-Lab will rely on the existence and good maintenance of the platform but the major trigger for sustainability is a good network of Go-Lab teachers and ambassadors. We highlight a few good cases where teachers were training other teachers in their schools and/or school communities.

3.5.1.1 Success stories from Portugal

The Portuguese national coordinator (NUCLIO) is a certified training centre in Portugal and successfully managed to accredit a course devoted to Go-Lab. The course was repeated in several parts of the country, including one of the islands. Teachers participating in the course were enabled to receive 1 credit, a minimum they need to earn every year in order to progress in their career.

Besides this important accreditation model, NUCLIO celebrated an agreement with the Ministry of Education that formally endorses Go-Lab for the quality of its tools, resources and methodology.

César Marques is a teacher in a vocational school in Portugal. He participated in Go-Lab activities from the very beginning of the project. In a recent online talk this trajectory was revisited. César perfected his skills in the use of IBSE and started using Go-Lab for most of his lessons with his students. He successfully trained Luis Esturrado, on the right in fig 3.5. Luís created 48 ILSs (of which nine were published at Golabz) and implemented them with more than 100 students in various classrooms.

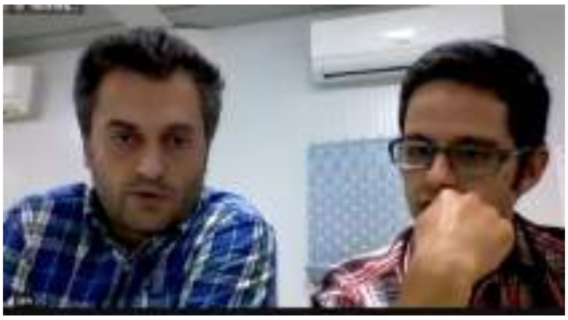


Figure 3.4 Go-Lab ambassador and trainee (Mr. Marques (l); Mr. Esturrado (r)).

César was very active teacher, having created over 100 ILSs and helped perfect the authoring tool. He is now keen in exploring the multidisciplinary possibilities using Go-Lab and wishes that more teachers in Portugal would share their ILSs so that topics of the curriculum would be well covered and exchange of good ideas could take place. They both claim that the biggest obstacles were overcoming their own fear. During the last school year César presented his work in Go-Lab in several national and international events.

Marília Peres got in touch with Go-Lab during a visionary workshop conducted in Portugal. She participated in the Go-Lab summer school in 2015 and learned for the first time how to use the system. Her school have only one computer room which made it difficult to implement Go-Lab. She found the perfect solution, she could request the library room, where some computers were available, and implement Go-Lab there. She successfully created 27 ILSs (three of them published at Golabz) and implemented them with over 177 students. The impact on the students was huge, they completely changed their attitude towards science. Following this success, and being a certified trainer in Portugal, she accredited a Go-Lab course and promoted it to teachers in her school cluster. **Marina Balbina** was one of these teachers she created 8 ILSs (three of them published at Golabz) and implemented them with 26 students. She applied to the Go-Lab contest and was one of the participants of the Go-Lab summer school in 2016.

Álvaro Folhas joined the Go-Lab project as a pilot teacher in the very beginning. He mastered the use of the system and engaged many students in the use of the system. In 2016 Álvaro's students took part in a scientific campaign promoted by the UK partner in the framework of a Go-Lab activity and supported the team in Cardiff to build the light curve of a recent spotted supernova. 16 ILSs, and 81 students.

3.5.1.2 Success story from Poland

Urszula Skolimowska participated in the Go-Lab training that was promoted during the ESA/GTTP training session in Leiden in 2014. Following this training she came with some of the teachers from her school, to a training course in Portugal where they participated in a 5-day training for Go-Lab. In 2015 they promoted a teacher training event in her school where several colleagues from her school and other schools in the region received training on how to use Go-Lab. Some of the teachers successfully produced ILSs and submitted these to the contest. Three of them were selected and participated in the Summer School. Recently they informed us that they will continue using Go-Lab in their schools, that they intend to promote more training events during this school year and also intend to create a training center to be able to engage more teacher in the use of innovative technology and in the use of tools such as Go-Lab authoring tool.

3.5.1.3 Success story from Bulgaria

Boryana Kuyumdzhieva is a mathematics teacher from Bulgaria. She was one of the participants of the training course Go-Lab promoted in Bulgaria. In her words *"Go-Lab was a great discovery for me*" as a very good tool to embed my inquiry lessons. According to her words, Go-Lab opened the possibility to easily share problems, engage students in creating their own hypothesis, promote fruitful discussions around student's conclusions and build their knowledge starting from their own ideas. She claims that it is very important to bring more training to Bulgaria where teachers are not accustomed to use ICT for teaching. There is urgent need to introduce and support teachers to follow this direction. For students English is not a barrier but for teachers it is, if we mix language issues with lack of ICT skills the problems scale up. She took this mission in her hands and started designing a strategy to engage more colleagues. She successfully promoted several training events in her country including a very important one during a UNESCO conference that took place in Sofia in June/2016. Boryana is doing a PhD and Go-Lab will be the selected tool to promote her research.

3.5.1.4 Special Needs on the spotlight in Greece

Nikos Nerantzis is a teacher of children with special needs. The beginning of his journey with Go-Lab was difficult because he was facing many technical difficulties. The new version of Graasp according to his words was “UAU”. For his teaching in particular he found the Big Ideas of Science a very useful tool to promote a more holistic learning experience to his students. His students were very happy and motivated to use Go-Lab. He claims that Go-Lab added an extra degree of freedom for teachers in special education. Great success stories followed in a school that don’t have good technical facilities. He participated in one of the Go-Lab online course about black holes and adapted the ILSs about black holes to his special needs students. Now his school is admitting children with visual impairment and he hopes to have the support from the team from Portugal that presented in partnership with the Faulkes Telescope team a set of examples on how to use Go-Lab with visually impaired children while using a robotic telescope and a thermal printer.

3.5.1.5 Best practices from non-Go-Lab countries (Armenia)

Artashes Torosyan is a physics teacher, headmaster of High School 198, Erevan, Armenia. Artashes was introduced to Go-Lab during a seminar for teachers and learned how to use Go-lab during a webinar delivered by Teodora Ioan. Following this training he introduced Go-Lab to colleagues in his school. Language was found to be an obstacle. The teacher didn’t seek for further online support as he found the system very intuitive. In a second phase he created short videos in Armenia in order to support other teachers. He now uses Go-Lab every time a lab can be introduced in a lesson. His students reacted with a lot of interest to the ILS and got used to them very fast. Parents also got aware of the project and reacted positively too by seeing how interactive the experience was for their children. Artashes hopes to have Go-Lab training in Armenia and translation of the materials. He is willing to become a Next-Lab ambassador.

4. The Effects of Community Building on Implementation

The above chapters have detailed the activities undertaken to apply the Go-Lab Community Support Framework. Overall, the activities can be characterised as successful in engaging teachers to register on Graasp and create ILSs, and that they have been well responding to the diverse needs for support and professional development. The diverse mix of physical and online based tools and activities have enabled teachers, students, and schools to prepare, develop, and implement ILSs as part of their work.

The aim of the current chapter is to investigate and quantify the impact that the support and training activities have had on the use and application of the Go-Lab system (i.e., the Golabz platform and the Graasp authoring platform). It summarises and evaluates the impact of the Community Support Framework Activities taking into account the user data of the Graasp Authoring Platform and analysing the data from Google Analytics as well as the data collected through a questionnaire distributed among the registered users of Graasp and participants of training and engagement events. It will present statistical evidence that indicates how the continuous professional development of teachers as part of Go-Lab have helped them to evolve from being merely interested "explorers" of the websites, to becoming "users" and eventually "co-developers" and "creators" of innovation. Many of them became Go-Lab "experts", trained and experienced users, who have piloted and implemented more than one ILS in their classrooms or other educational settings. In the best cases, those teachers have reached the stage of Go-Lab "ambassadors" who promoted the use of the system to other teachers and trained them as well (cascade effect).

When originally designing the framework (Doran & Sotiriou, 2015) we had looked into studies that showed - as in any human activity – that the expected engagement is proportional to the interest raised by a certain "product" and how this solution is addressing the personal needs of the individual or the community for that matter. The distribution categorizes users according to their actions. This is called the 90-9-1 Principle: 90% are classified as audience (observe but don't actively contributed), 9% editors (modifying content but rarely creating something new) and 1% creators (responsible for new contents) (McKee, 2009).

While we are using the 90-9-1 principle as a reference to demonstrate the capacity of the applied methodology and estimate the impact of the overall Go-Lab Community Support Framework, nonetheless, the expressed goal of the Support and Community Building Activities and Framework was to increase the user numbers and to outdo the above mentioned 90-9-1 principle.

The consortium was also well aware of the challenges in involving and supporting teachers to engage in innovation, especially given the limitations of the learning curricula, the lack of openness in school innovation culture in many countries and a lack of equipment in schools, and very often the exam driven orientation posed by school administration. On the other hand, in education there is no shortage of energy and expertise, and certainly no lack of commitment or moral purpose amongst teachers. The question that will try to be answered in this chapter is therefore, to what extent has the support methodology and the mix of services offered helped teachers to create and implement their own online learning space and to be(come) innovative?

4.1. User Analysis

4.1.1. Analysis of User Data

In the sections below an attempt is made to map the behaviour of Go-Lab users that have been targeted and engaged especially in the Go-Lab Community Support Activities and to demonstrate their ever increasing uptake of the system during the last two years of implementation. The aim is to understand to what extend the implemented Community Activities have clearly impacted the system use, registration and implementation.

The Go-Lab system used for the implementation of ILSs is based on two central online-based portals:

1) The **Go-Lab Portal** "**Go-Labz**" (http://www.golabz.eu/) which is the most important interaction point of teachers looking for online labs, published ILSs, or generally looking for information about the state of the art of remote and online labs in educational settings and their potential in classroom education;
2) The **Graasp Authoring Tool** (http://graasp.eu/) where registered users can create, copy, and implement Inquiry Learning Spaces (ILS).

The key indicators of the usage of Go-Lab system, from September 2014 to July 2016 are presented in the Table 2.1. This table presents an overview of the main indicators that have been used in the analysis. The numbers presented are derived from two main sources, the weblog of the system (Graasp) and Google Analytics which provides a monitoring mechanism that tracks the use of the different components of the Go-Lab system (Golabz portal, Graasp platform, and Tutoring platform).

Table 4.1 Analytics of Golabz and Graasp.

Platform	Golabz		Graasp	
Period	Oct 2014 – Aug 2015	Sept 2015 – July 2016	Oct 2014 – Aug 2015	Sept 2015 – July 2016
Total numbers of unique user (Google Analytics)	**29.079**	**60.194**	**12.409**	**32.085**
Bounce Rate (Google Analytics)	38.10%	48.17%	61.30%	21.76%
Unique Users (Google Analytics - bounce rate removed)	18.000 (teachers)	31.198 (teachers)	4.792 (teachers)	25.103 (teachers and students)
Page Views / per Session (Google Analytics)	4.7	4.2	2.55	11.92
Average Time (in min) (Google Analytics)	05:09	04:18	06:21	10:29
Clicks on create ILS button (Google Analytics)	3.242	12.652		
Clicks on copy ILS button (Google Analytics	2.545	5.885		

It should be noted that the user data in google analytics for does not distinguish between teachers / creators and students / stand-alone users (std). While in Phase B (October 2014 – September 2015) mostly teachers were using the system, in Phase C (October 2015 – July 2016) the system started also the tracking of students entering and using the Graasp authoring tool to implement the ILSs created by the teachers.

This numbers are clearly reflecting a successful dissemination of the project as it can be seen by the number of new visitors to Golabz. This is also reflected in the numbers of visitors to Graasp that, in spite the fact that numbers are not really comparable, since we have for the last period the inclusion of the traffic generated by the students, the system is being used by a larger number of registered users that are exploring the platform in more depth.

4.1.2. Analysis of the development of teacher competences

As presented in (Doran & Sotiriou, 2015), Go-Lab supported teachers to build their competence profile and acquire the desirable level of proficiency in the use of the portal and the authoring tool. The level of maturity of Go-Lab users ranged from those choosing to be explorers of the system, where basic ICT skills will suffice, to those that mastered enough in the use of the system and became ambassadors by training and involving other colleagues in the use of Go-Lab. The support framework presented had different components in order to support the different proficiency levels according to Table 4.2.

Table 4.2 Teachers competence profile.

	Explorer	User	Developer	Pilot	Ambassador
Using the Go-Lab environment	Get acquainted with Go-Lab portal and the ILS model	Explore and adopt some ILS	Create their own ILS	Implement ILS with their students	Train others
ICT Skills	Basic ICT skills	Acquainted with the use of online labs and simulations	Capable of developing online lessons and create metadata	Skilled in the use of ICT, in the creation of learning scenarios, etc.	Capable of sharing their expertise with others
IBSE experience	New to IBSE	Some experience in student centred teaching	Has experience in the IBSE model	Skilled in using the IBSE model with students	Master IBSE and is capable of introducing others to the concept
Online / Remote Labs	Integrate some labs in their lessons	Integrate ILS in their lessons	Develop ILS and pilot test them	Integrate the use of ILS in several lessons	Support other teachers to implement ILS in their classrooms

Using our analysis, we were able to collect evidence of different levels of Go-Lab teachers participating in the project and to what extent we managed to support their development to the level of ambassadors. Training courses promoted at a national level and international gathering events such as the summer schools were key to improve their competence profile to the maximum extent. Their path can be summarized as follows

- **Explorers** – Visitors exploring the collection of online labs, published ILSs, apps, etc. (Usually participants of Visionary Workshops and/or dissemination events);

- **Users –** Registered members of Graasp that are somehow using the system by copying and/or repurposing an existing ILS or creating a new one. (Usually participating in training events and/or using the support facilities available at Golabz);
- **Developers/Creators** – From the above users a few are really exploring the system by creating ILSs that are following the inquiry methodology, that contain labs and apps, etc (Usually participating in training events and using the support facilities available at Golabz);
- **Pilot Implementers** – Some of the developers reach the mature stage where they are now capable of implementing ILSs with the students. (Usually participating in training events, practice reflection workshops, pilot's days and demo activities in schools);
- **Ambassadors** - And finally those that are already in a position to train other teachers and promote the development of collaborative instances.

The summer schools and the national training events were used as a space where we could gather valuable information from the participants and continuously improve the system accordingly. Teachers participating from the very early stages were key to the success of the project but also evolved in their professional development while supporting Go-Lab.

Table 4.3 Allocation of Go-Lab users in competence profiles (July 2016).

	Total number	Percentage
Explorers (100% of users)	31.398	100%
Users (registered to Graasp)	6517	20.89%
Developers/Creators (of an ILS)	3877	12.43% of Golabz explorers became creators 59.5% of registered users to Graasp became creators
Pilot - Implementers (with more than 5 std users)	339	1.09% of Golabz Explorers became pilot implementers 8.7% of creators became implementers

In reference to the above mentioned "90-9-1 principle", it can thus be shown, that Go-Lab has surpassed its self-imposed goals and exceed the percentage of use. Not 9%, but 20,89% of all visitors / explorers have become users that registered in Graasp. Even more impressive: not 1%, but 12.43% of all explorers have become (co-)developers of content. As will be shown further below, this can to a great extent be related back to the impact of the support activities of WP6.

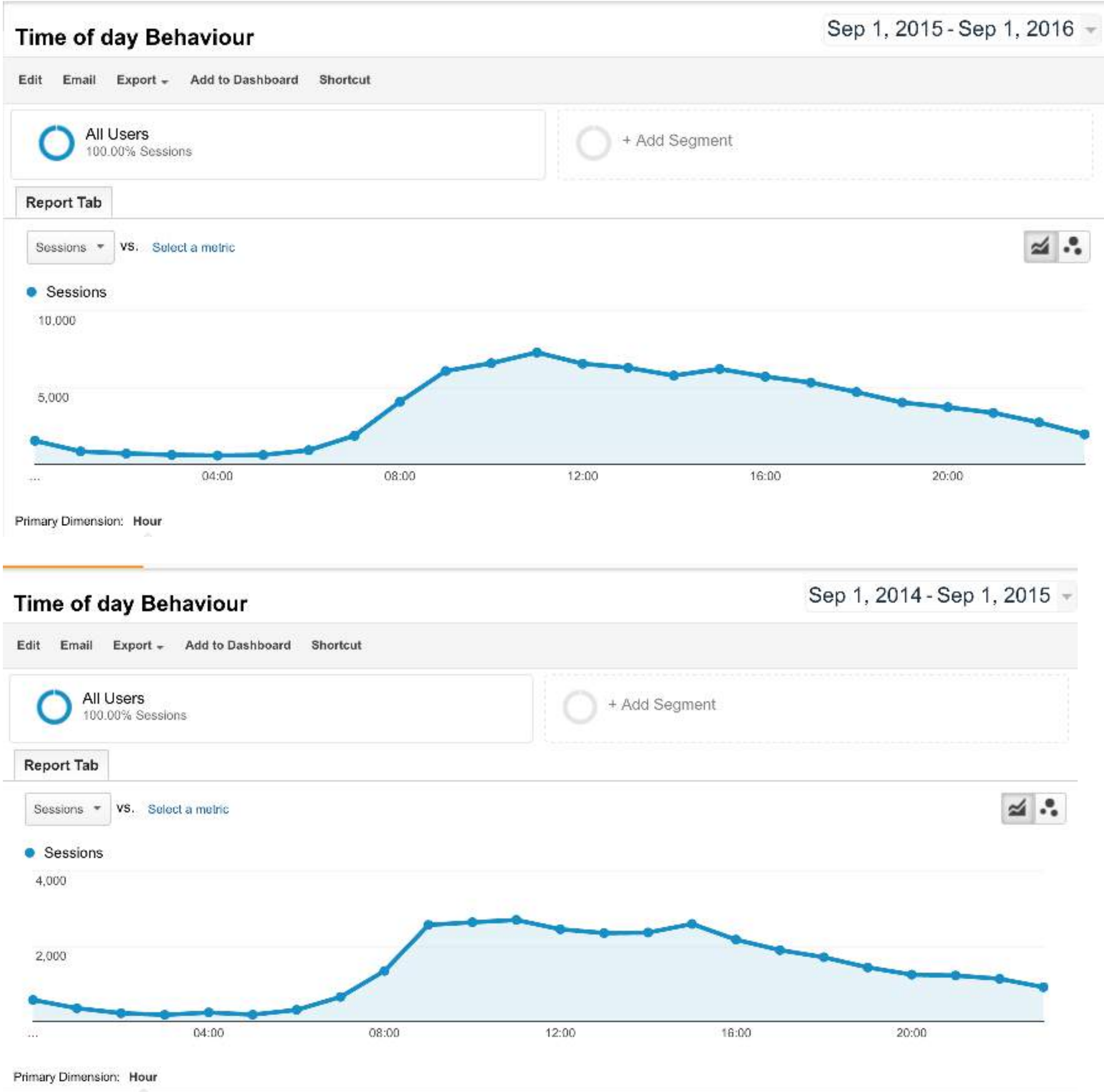


Figure 4.1 Time of the day behaviour of Graasp users.

Considering the time of the day when the system has a peak of use, from 08:00 to 17:00, we can also conclude that this is taking place during school hours as can be seen in Figure 4.1. In the bottom part of the figure numbers only refer to teachers using the system as the upper part is now also including students. We can also see that the system is being used beyond school hours, in the previous phase by teachers, probably while preparing their ILSs.

Overall, these numbers are very encouraging as they are indicating the level of maturity of users that are progressively exploring the system more in depth and taking Go-Lab into their classroom settings.

As will be discussed in chapter 5, 1.692 teachers were trained in activities promoted by NC and 3877 created ILSs. This means that for each trained teacher 2.29 became creators of content. This we understand as being a clear indicator for the cascade effect of experienced teachers training other teachers in the use of the system, especially of the Go-Lab Ambassadors and teachers that implemented several pilots.

4.2. Impact of support activities and mechanisms

As a next step, we investigated whether there is a significant impact and difference in the creation and implementation of ILS with a given amount of stand-alone users (potential students) between the countries where the full Go-Lab Community Support Methodology was applied (i.e., Go-Lab countries) and those countries where mostly the online support was available (i.e., non-Go-Lab countries). We also investigated the impact of the summer schools and a pilot study in one of the Go-Lab countries, Portugal.

The table below presents the overall number of registered users in Graasp, the total number of authors and those that created at least 2 and those that have created at least 10 ILSs. If broken down between partner countries and non-partner countries, summer school participants and the particular case of Portugal trained and non-trained teachers, we get the following results:

Table 4.4 Behaviour of different users in terms of creation of ILSs.

Registered Users in Graasp (October 2014- July 2016		**Authors (= creator of ILS)**		**Authors of 2 to 10 ILS**		**Authors of more than 10 ILSs**	
		Number of Authors	% of registered Graasp users	Number of Authors	% of registered Graasp users	Number of Authors	% of registered Graasp users
All	6.517	3.877	59%	1.828	28%	116	1.8%
Go-Lab countries	2.041	1.176	58%	652	32%	63	3%
Non-Go-Lab countries	1.072	637	59%	272	25%	16	1.5%
Summer School (2015/2016 participants)	66	66	100%	30	45%	22	33%
Portugal (not trained)	151	105	70%	65	43%	0	0%
Portugal (trained teachers)	125	102	82%	50	40%	5	4%

N.B. The difference of users in the sum of “Go-Lab countries” and “non-Go-Lab countries” to “All users” results from the fact that a considerable number of users could not be allocated to a specific geographical location.

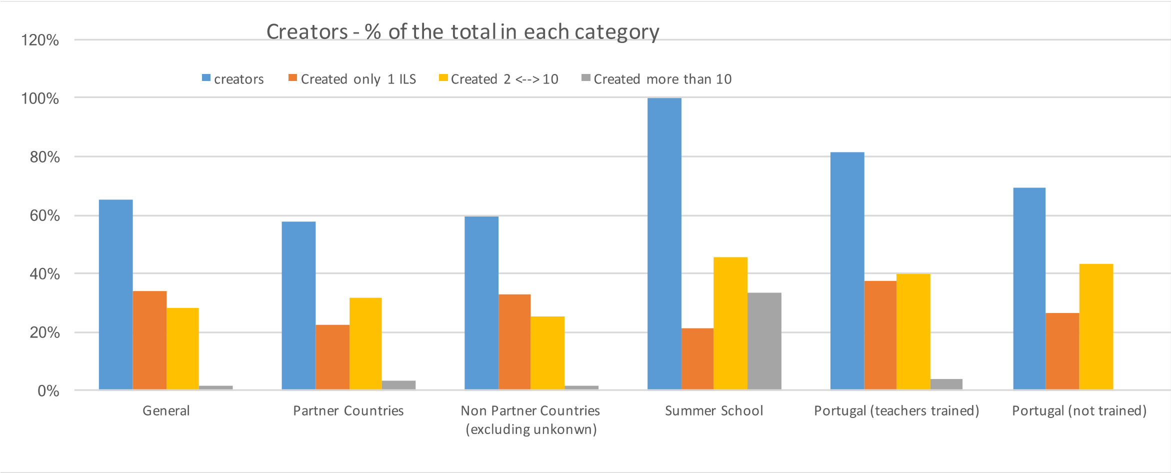


Figure 4.2 Comparison among creators of different groups.

Country identification in the figure above was based in how this was declared by the teacher. Some cleaning was done in order to ensure teachers from other countries were not part of e sample selected for a more in-depth study (summer school and Portugal), for the studies referring to Portugal to properly place teachers that received some sort of training from those that didn't.

It is clear from the graph that teachers from partner countries have a tendency to create a larger number of ILSs, but the effect of community building activities are more evident in the summer school participants, in general they created far more ILSs, in percentage, than the other studied groups. In the case of the Portuguese trained teachers we find an interesting result that the percentage of teachers creating 2 to 10 ILSs is larger than the number coming from the trained teachers, However, trained teacher also had a percentage of creators who went beyond the creation of 10. These results are showing that the system is mature enough to support teachers that are not reached by our training efforts as national coordinators. In this case, the support provided by the platform is enough to encourage the copy and creation and repurposing of ILSs.

The case changes a little bit when we study the number of implementers as can be seen in Table 4.5 Behaviour of different users in terms of implementation of ILSs Table 4.5 and Figure 4.3.

Table 4.5 Behaviour of different users in terms of implementation of ILSs.

Registered Users in Graasp (October 2014- July 2016)		Authors who created at least one ILS with 5+ std		Authors who created at least one ILS with 10+ std	
		Number of Authors	% of registered Graasp users	Number of Authors	% of registered Graasp users
All	6517	348	5%	256	3.9%
Go-Lab countries	2041	187	9%	135	7%
Non-Go-Lab countries	1072	21	2%	18	1.7%
Summer School (2015/2016 participants)	66	50	76%	46	70%
Portugal (not trained)	157	11	7%	5	3%
Portugal (trained teachers)	125	34	27%	16	13%

N.B. The difference of users in the sum of “Go-Lab countries” and “non-Go-Lab countries” to “All users” results from the fact that a considerable number of users could not be allocated to a specific geographical location.

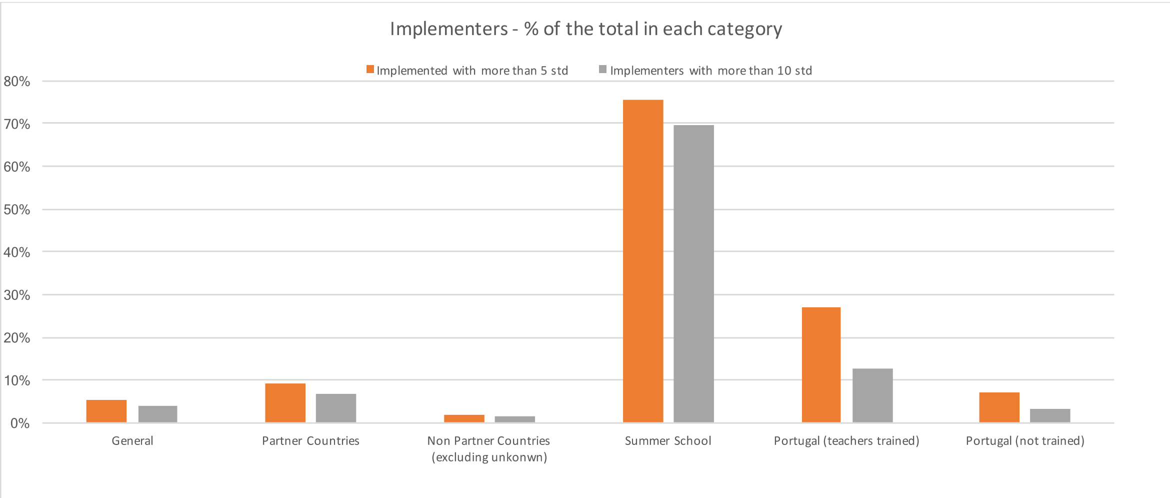


Figure 4.1 Comparison among implementers per category

This graph shows a strong correlation between those teachers and authors who were engaged in the Community Support Activities in Go-Lab countries and the higher success rates in bridging the gap between ILS creation and implementation. This assumption is backed up by the examples of summer school participants. The effect of having a direct contact with peers and being able to discuss the creation and implementation of ILS in a workshop is leading to a significant higher rate of authors that are actually implementing the ILS they created. We can therefore with some caution assume that the physical workshops and/or the personal contact of Go-Lab partners to participants had a direct quantifiable positive impact on the implementation of their created ILSs. The contests had a requirement that their submission should be the result of an implementation instance. The interesting fact is that they implement much more than what was required. For the Portuguese trained teachers there was no requirement for implementation and still there are several cases of implementation in several different dates by several teachers.

The main user data allows us to draw the following assumptions:

- Overall user numbers of the Go-Lab system are significantly higher (65.59%-20.89%-12.43%) than the 90-9-1 model predicts in both Go-Lab countries and non-Go-Lab countries;
- In countries where the Go-Lab Community Support Framework & Methodology was fully implemented, better results in the creation and implementation of ILS have been observed compared to non-Go-Lab countries;
- As many of the support tools and activities were online, there is a strong indication that physical (training) workshops and other events (such as summer schools) made the pivotal difference in creation and implementation of ILSs;
- There are indications that physical events and the direct contact to Go-Lab partners lead to a higher creation and implementation of ILSs, and are therefore more efficient and effective than the online-based support activities (e.g. MOOC, Support age, Forum, etc.). It seems that whenever a user was involved in a Go-Lab partner country, the direct support, the continuous personal contact, have resulted in more created and implemented ILS;
- This result also reflects the challenges and constraints faced by many teachers in implementing ILS in their school. Without ongoing or direct support, it seems to be more difficult to introduce Go-Lab into the classroom;
- A total of 6517 users and 3877 authors are recorded in the Graasp system, while only 1.692 teachers were trained in physical or virtual workshops. This has to be understood as one of the main achievements of the Community Support Activities. Only the activities of WP6 can explain that for every teacher trained in a physical workshop ➔ 4 non-trained users have registered to Graasp, and ➔ 2,29 non-trained users have become authors.

Overall, the factors contributing to the different usage of the Go-Lab system are influenced by a variety of different sources. Taking into account that training teachers on the use of the system requires a hibernation time for practicing, reflecting and adaptation to the curricula, we have to note that the presented numbers have exceeded our expectations by far.

4.3. Findings of the framework support questionnaire

In order to further understand the impact of the support activities promoted by the consortium, while following the designed framework, we have invited teachers that participated in training events, contests, and summer schools to provide more in depth information about the importance of the various support mechanism put in place (in total we invited 130 participants of training events and 66 participants of summer schools). We retrieved 67 responses. We summarise here the most important conclusions:

- Most responders were aware of the different support activities promoted by the consortium with a higher incidence in the summer school, the contest and the online support;
- 61 % of the responders participated in the various summer schools. 52% took part in training workshops (both expected percentages since the sample selected for this study were from summer schools and training workshops);
- 48% used the provided online support and materials;

- 43% of the responders participated in Go-Lab contests;
- 34% received direct support from a colleague (a Go-Lab ambassador);
- In general, they considered that the provided support on site and online was adequate and suitable;
- 50% of the responders consider the several reflection and experience exchange activities important for their participation in Go-Lab;
- 60% considered the pilot's gathering days very important for their achievements in the project;
- 90% considered training workshops important or absolutely important for their professional development with Go-Lab;
- over 50% of responders also consider MOOCs and webinars important;
- 88% consider their participation in summer schools important and 78% consider the online training workshops and tutoring platform important;
- Over 90% consider the online support page material important;
- Over 70% found the demo activities in schools equally important (15% of responders didn't know about this possibility);
- The participation in international contests was considered important by 70% of responders and the same percentage is attributed to the attribution of certificates;
- Social media and regular emails from the coordination of the project was considered an important mean of communication by over 70% of responders;
- 80% consider that receiving support from other colleagues or being in direct contact with Go-Lab representatives is important.

In terms of creation of ILSs and their respective implementation 46% of responders from this group have created 2 to 3 ILSs but in total over 20% have created more than 4. In terms of implementation, 43% stated that they have implemented between 2 and 3 ILSs in educational settings, 16% between 4 and 6 and more than 10% have implemented more than 10 ILSs.

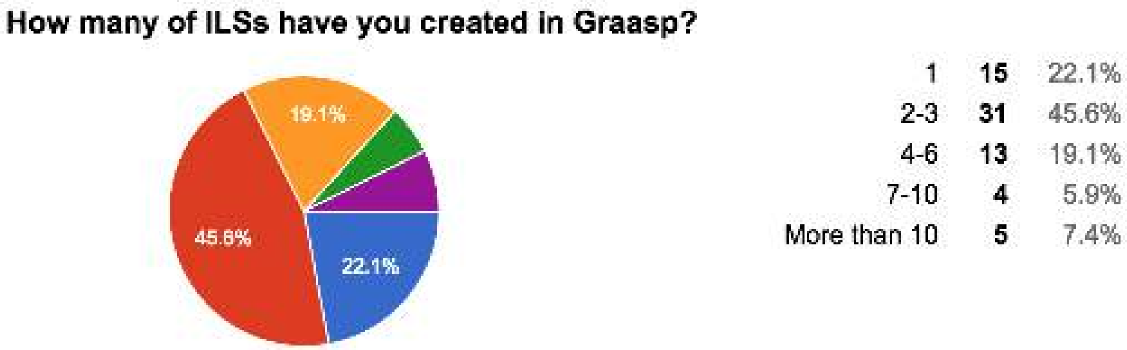


Figure 4.4 Number of ILSs created

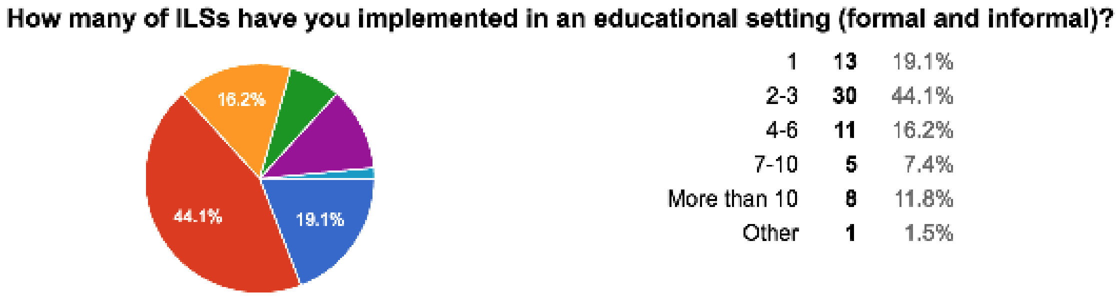


Figure 4.5 Number of ILSs implemented

In relation to the creation of their ILSs and their proficiency on the use of the inquiry based learning methodology, responders considered that the supporting tools and activities were very useful for their understanding of the methodology and thus the design and creation of ILSs. The majority considered that it would be difficult to have created an ILS without the support provided by Go-Lab. However, 20% stated that they could create an ILS without need of support.

Would you have created a ILS without the support tools & activities offered in Go-Lab?

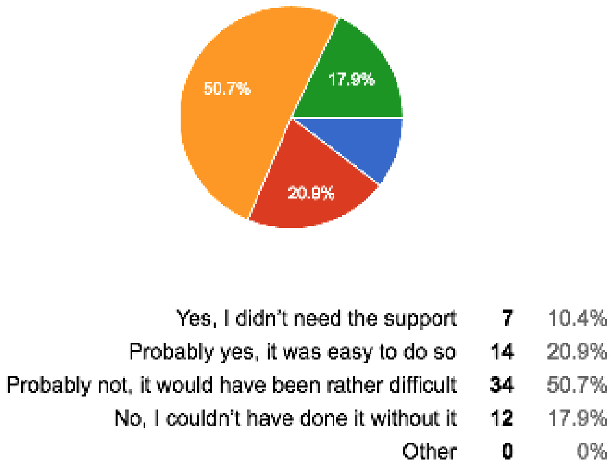
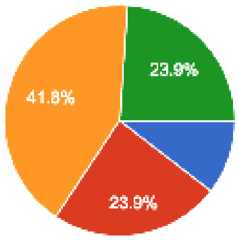


Figure 4.6 Expressed need for support to create an ILS

When asked about the importance of the support mechanisms in order to reach the next stage, the implementation phase, the reactions were similar were 65% required the use of the supporting tools but 33% stated that they could do it without the existent support

Would you have implemented a ILS without the support mechanism offered in Go-Lab?



Yes, I didn't need the support	7	10.4%
Probably yes, it was easy to do so	16	23.9%
Probably not, it would have been rather difficult	28	41.8%
No, I couldn't have done it without it	16	23.9%
Other	0	0%

Figure 4.7 Expressed need for support to implement an ILS

We also asked responders what other types of support they would have liked to receive they suggested: the promotion of more webinars, the existence of more labs and apps, more support from colleagues and the possibility to collaborate online, more training workshops, tutorials on how to use the different labs. But the majority of responders stated that the existent support was enough and adequate.

The next part of the survey was to find what tools and activities they have recommended to their colleagues:

- **35%** recommended the visionary and summative workshops, 40% the practice reflection workshops.
- **49%** recommended the participation in the pilot's days
- **77%** the participation in training workshops.
- **46%** recommended to colleagues their participation in the MOOCs and 56% in the webinars
- **90%** of responders recommended the participation in the summer schools
- **76%** recommended the participation in online training workshops and 73% the use of the tutoring platform.
- **78%** recommended the use of the online support page
- **73%** recommended the participation in the international contests.

We also wanted to measure to what extent this selected group encouraged other colleagues to take part and use the different supporting tools and mechanisms existent: online support page and training workshops scored high with 67% and 61% respectively of responders stating that they have used these activities to engage other colleagues, summer schools and tutoring platform followed with 53% selecting this option. International contests were selected by 48% of the responders.

Around 82% of responders stated that they are in regular contact with other Go-Lab teachers outside their schools. And from those over 56% are in contact with colleagues from other countries.

We also left a space for participants to leave their own thoughts and the general positive attitude towards the project were very encouraging:

- “remember 3 years ago I organized jointly with the expert science of Pleven (Bulgaria) first workshop with teachers of physics and astronomy - there was very little work online laboratories, but the enthusiasm of the teachers were great - for the first time had the opportunity to learn about these laboratories of collected in one place. Last year again proved home regional training - things are quite different - teachers easily found the necessary resources and easy to use platform Graasp, gained courage to try to create their Inquiry Spaces. Extremely project development thanks to the work of enthusiasts with high professionalism and responsibility!”
- “Go-Lab was the best project so far I have participated in.”

5. School-based Implementation Activities

The following chapter describes the main findings, results and effects of school piloting also to the usage of the Go-Lab system, carried out in the past years. The implementation of the Go-Lab project took place in 3 phases covering 3 consecutive school years. The pilot schools were mainly recruited from countries where partners are based (the Netherlands, Greece, Belgium, Cyprus, Germany, Spain, Austria, Estonia, Switzerland, UK, and Portugal) and also from Bulgaria, Romania, Poland and Italy. In Phase-A more than 100 pilot schools were recruited (Lauritsen, 2014) and their activities were reported in (Mavromanolakis, 2015a). In Phase-B about 500 more schools were added in the network of pilot sites (Tasiopoulou, Mihai & Collado, 2014) and (Mavromanolakis, 2015b). In Phase-C 500 more schools from the network of countries joined the activities of the project (Tasiopoulou, Ioan, & Scheeck, 2015). Phase-A started in M16 (Feb.2014) and lasted 6 months, Phase-B started in M25 (Nov.2014) and lasted 9 months and Phase-C started in M37 (Nov.2015) and also lasted 9 months. Before and during each phase various in-school implementation and community building activities were planned to take place in each country organised by the partners of the consortium in order to attract, engage and train science teachers in the Go-Lab project so that they then implement its approach in their schools.

In general, an implementation activity intends to bring into the classroom practice the use of online labs and related resources in an innovative and engaging way so that both teachers and students have a stimulating experience in science education. Series of support activities such as presentation seminars and training workshops are organised for teachers, in order for them to get familiarized with the relevant technology, gain knowledge and confidence and be able to adopt and also adapt the use of online labs in their everyday school practice.

All in-school activities with students and pre-preparatory and support actions such as training workshops for teachers, both referred in the following as implementation activities, events or actions, are centrally coordinated by the WP7. These activities are also managed locally by one partner in each of the pilot countries who acts as the National Coordinator and is responsible for the local management and localization of the project resources and activities. It should be noted that the Go-Lab consortium is composed of partners with diverse background and there are countries that are represented by a partner or partners with limited or no experience in education. In the spirit of a collaborative and shared effort those partners are given every feasible support and guidance by more experienced partners.

For Phase-A and B national coordinators and partners offered and conducted comprehensive training for teachers covering the pedagogical and technical aspects of the Go-Lab approach. They also organized and conducted several activities where students participated. They continued the effort during the third and final Phase-C keeping a good balance between teacher trainings and in-school activities with students. For each partner activity a report according to a template is issued. The implementation activity reports compose a key part of the management and coordination of the overall effort and also of the public image of the project. Material included in them were usually used also in dissemination actions and project promotion documents. The reporting of the implementation activities were periodically reviewed, discussed in the relevant work-package meetings in order to measure progress and provide feedback to and from the national coordinators and the partners involved in the organization and implementation of educational activities. The reports and results were regularly updated and presented at consortium meetings. Through the reporting procedures that partners followed it was guaranteed on one hand an open and constructive exchange of experiences, best practices and difficulties faced and on the other a synchronization of effort among partners.

In the following, first are presented the results of implementation activities conducted by partners during the nine-month period of Phase-C. The corresponding full list of produced reports is included in Annex II of (Mavromanolakis & Doran, 2016). The cumulative summary of results from all implementation phases are also presented. Then follows the analysis of the data from the usage of the system.

5.1. Partner activities for Implementation Phase-C and summative results for all implementation phases

Implementation Phase-C covered the period from project month 37 to month 45, which corresponds to 1 Nov 2015 – 31 Jul 2016. During the 9-month period partners organized and conducted 67 implementation activities around the host countries and beyond. Of which, 28 were training workshops for teachers with 518 participants from 357 schools and 39 were activities with students with 1889 participants from 101 schools. The total summative results after Phase A, B and C are: 1692 teachers from 1041 schools attended the training workshops that partners organized; 4283 students from 218 schools participated in the activities that partners organized. Summative, and per country, number of teachers, students and schools that participated in implementation activities organized by national coordinators and partners in Phases C, B, A, and in total, are tabulated in Table 5.1 shown below. The full list of activities is also shown in Annex II Table 2.1 which tabulates the main details of each event/activity, namely country, partners involved, dates, type of activity, participant teachers or students, online labs practiced and subject domains. Annex II contains also all the reports wherein partners documented each activity.

Table 5.1. Summative and per country number of teachers, students and schools that participated in implementation activities organized by national coordinators and partners in Phases C, B, A and in total.

	Austria	Belgium	Cyprus	Estonia	Germany	Greece	Netherlands	Portugal	Spain	UK	Other	Total
PHASE-C												
Teachers participated in Go-Lab Trainings	7		19		8	79		71	84	45	205	**518**
Students participated in Go-Lab Activities			222	133		572	676	156	112		18	**1889**
Schools participated in Go-Lab Trainings	7		19		8	68		47	60	18	130	**357**
Schools participated in Go-Lab Student Activities			5	6		64	14	7	4		1	**101**
PHASE-B												
Teachers participated in Go-Lab Trainings	0	85	64	10	54	99	10	306	147	15	4	**794**
Students participated in Go-Lab Activities	80	0	178	208	0	471	338	510	0	0	49	**1834**
Schools participated in Go-Lab Trainings	0	55	20	5	24	68	5	62	92	8	1	**340**
Schools participated in Go-Lab Student Activities	5	0	9	4	0	54	4	3	0	0	1	**80**
PHASE-A												
Teachers participated in Go-Lab Trainings	22	73	2	4	2	85	10	75	49	30	38	**380**
Students participated in Go-Lab Activities	52	0	0	0	0	278	230	0	0	0	0	**560**
Schools participated in Go-Lab Trainings	16	57	2	2	2	77	5	71	49	30	38	**344**
Schools participated in Go-Lab Student Activities	4	0	0	0	0	29	4	0	0	0	0	**37**
TOTAL AFTER PHASES A+B+C												
Teachers participated in Go-Lab Trainings	29	158	85	14	64	263	20	452	280	90	247	**1692**
Students participated in Go-Lab Activities	132	0	400	341	0	132 1	124 4	666	112	0	67	**4283**
Schools participated in Go-Lab Trainings	23	112	41	7	34	213	10	180	201	56	169	**1041**
Schools participated in Go-Lab Student Activities	9	0	14	10	0	147	22	10	4	0	2	**218**

5.1.1. Teachers and Schools participated in Go-Lab trainings organized by partners

Figure 5.1 depicts the number of teachers that participated in Go-Lab trainings per partner country in Phase A, in Phase B, in Phase C and in total. Figure 5.2 shows the number of schools involved in Go-Lab teacher trainings per partner country in Phase A, in Phase B, in Phase C and in total. As can be seen there is variation on country per country level. This is expected and explained to some extent after taking into account the difference in allocated person-months and resources per partner to conduct activities with schools, teachers and students. Further to that the variation of achieved results is because of several systemic factors, among others:

- the flexibility of the national educational system in introducing innovative methods and practices in particular in science or STEM education or in general;
- the current ICT infrastructure in schools. This refers to the status of baseline software and hardware equipment, frequency of regular upgrades, ratio of availability per student or classroom, etc.;
- the general attitudes, skills and interests of teachers. This includes the level of motivation and encouragement they need in order to exit their comfort zones.

Throughout the implementation phases of the project it is observed that the most crucial factor is being the culture and attitude of science teachers, and in general the education system as a whole, across different countries and how flexible or prone they are in adopting inquiry teaching and innovative learning approaches, the use of online labs in science education etc. The second most significant factor is being the flexibility of the national curriculum and the level of freedom is allocated to schools and teachers to choose, design and implement their teaching practice. In this context in Greece, Spain, Portugal, Cyprus, Estonia, the Netherlands, better overall results were achieved compared to Austria, Germany, UK, Switzerland.

With respect to the results shown in these figures, it should be noted also that during Phase-C considerably more training opportunities were offered and organized for teachers outside the consortium host countries. In this way the interest of teachers from other countries was accommodated facilitating the expansion of the project.

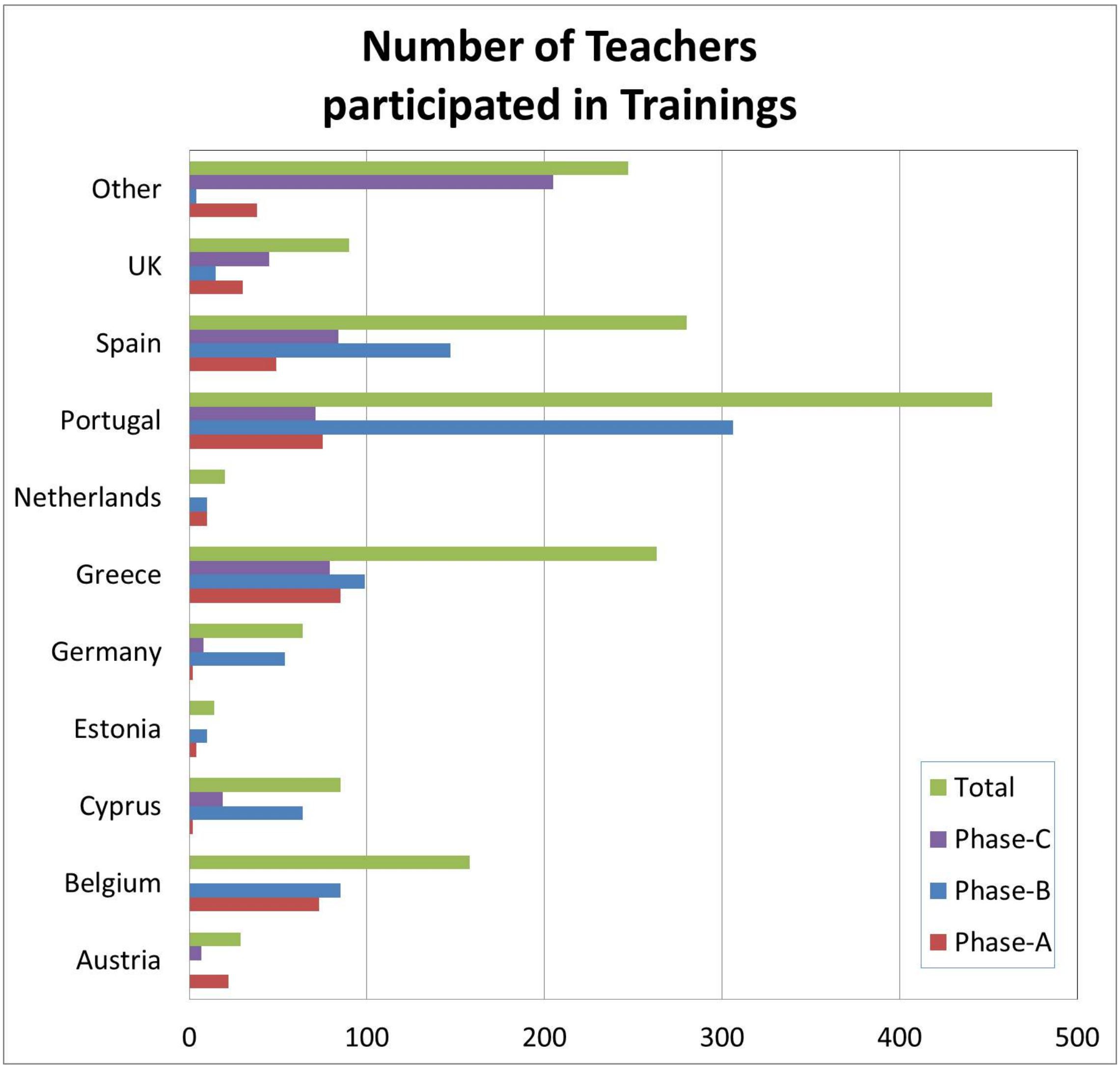


Figure 5.1 Number of teachers who participated in Go-Lab trainings per partner country

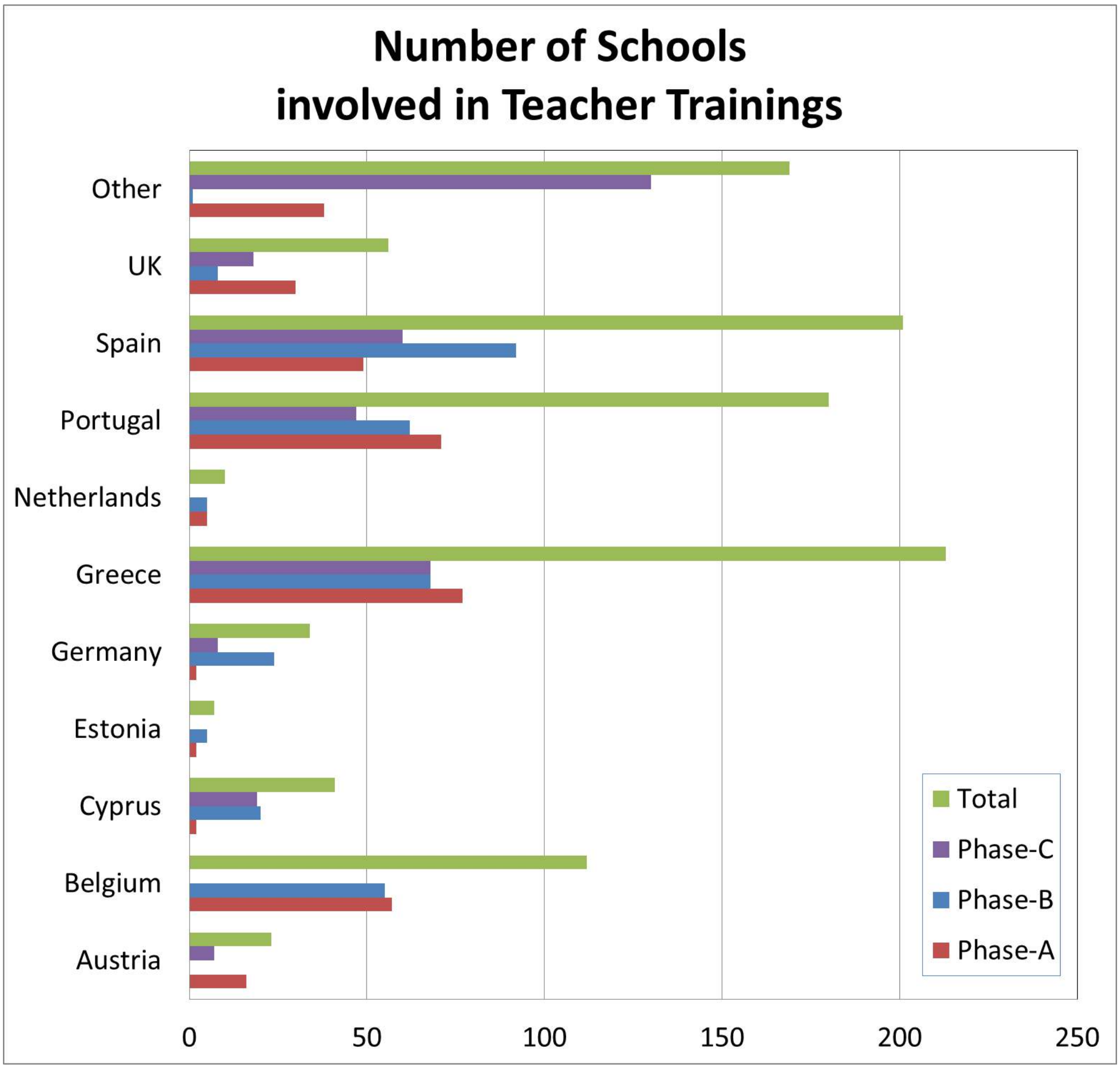


Figure 5.2 Number of schools involved in Go-Lab teacher trainings per partner country

5.1.2. Students and Schools participated in Go-Lab activities organized by partners

During the implementation of the project it is generally observed that in most countries and cases there was large expression of interest from schools and teachers to join the project and attend the trainings. However, teachers then found considerable difficulty to implement what they learned in their everyday teaching practice. As a result, the national coordinators and partners devoted significant effort to organize and conduct themselves in-school activities with students in order to demonstrate and facilitate their uptake, and to provide support to teachers.

Figure 5.3 depicts the number of students participated in Go-Lab activities organized by partners and their distribution per country in Phase A, in Phase B, in Phase C and in total. Figure 5.4 depicts similarly the corresponding number of schools involved in Go-Lab activities with students organized by partners per country in Phase A, in Phase B, in Phase C and in total.

As already mentioned there is large variation on country per country level due to the same aforementioned factors. Further to these, the expertise and the experience of partners responsible in conducting such activities in secondary or primary education played a critical role. In this context in Greece, Portugal, Cyprus, Estonia, the Netherlands, better overall results were achieved. These are also in line with generally a better achieved balance between teacher trainings, follow-up student activities and overall distribution of schools involved.

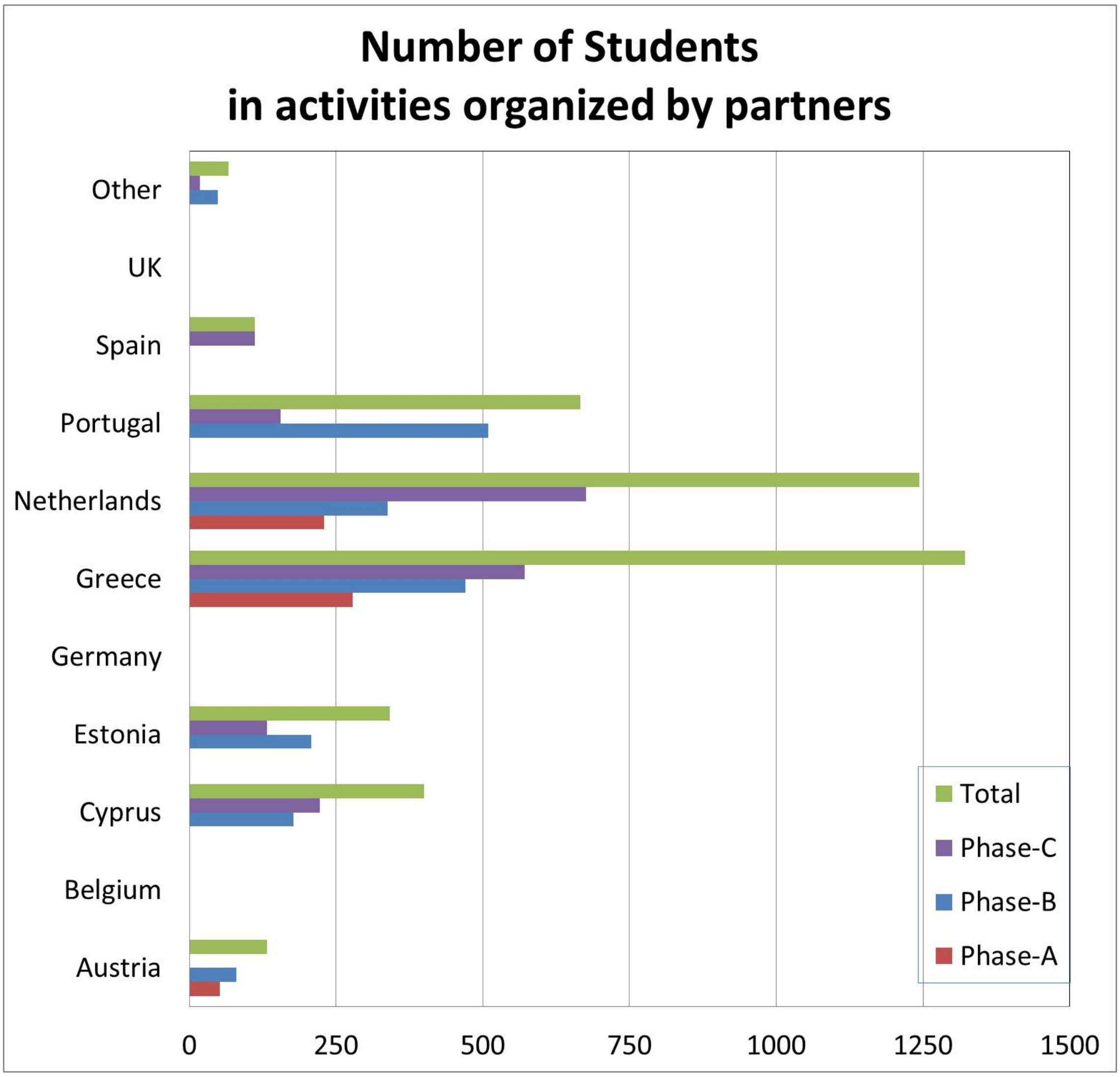


Figure 5.3 Number of students participated in Go-Lab activities organized by partners per country

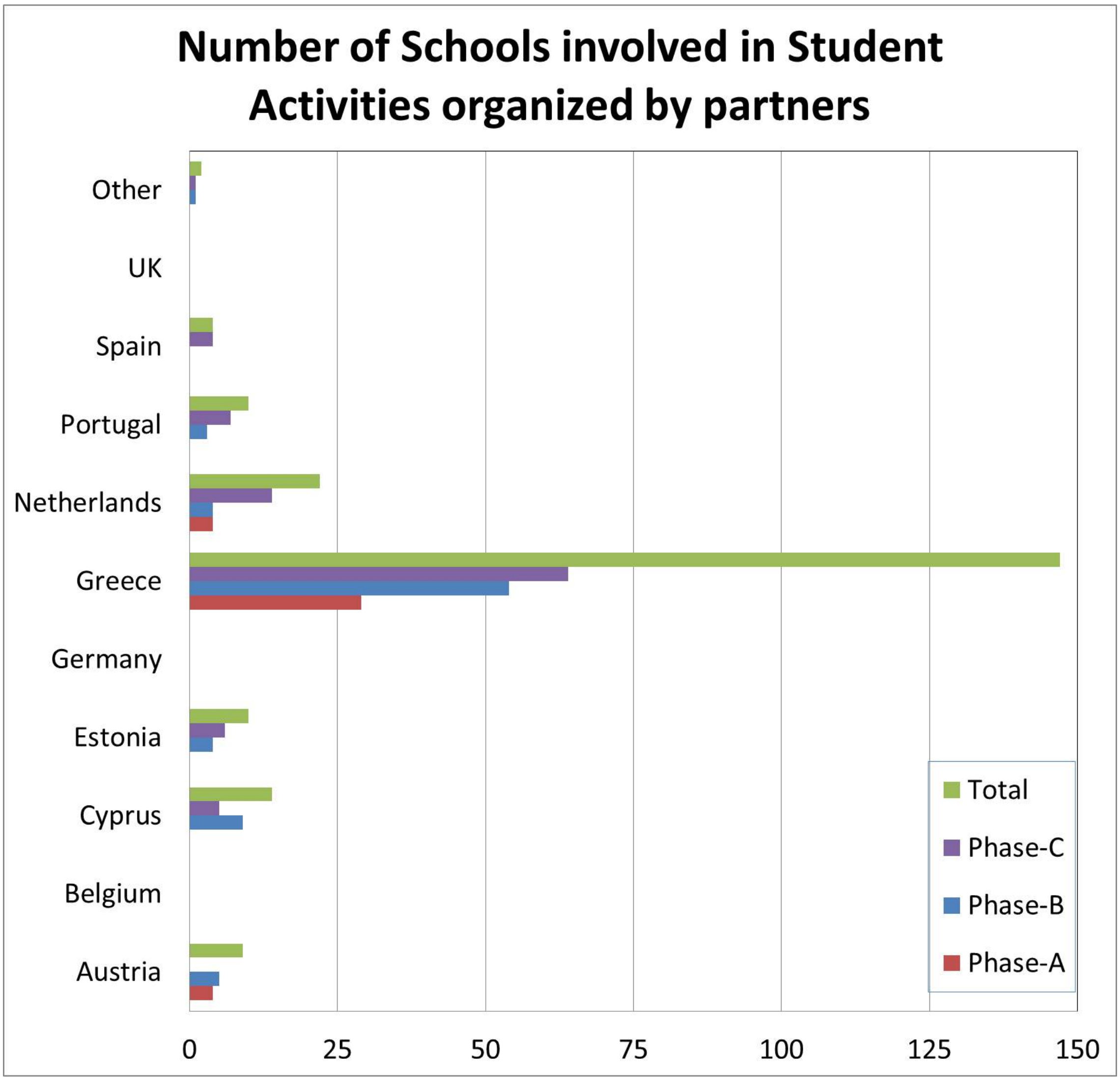


Figure 5.4 Number of schools involved in Go-Lab activities with students organized by partners per country

5.1.3. Subject domains of online labs utilized in Go-Lab activities organized by partners

The online labs that partners demonstrated and introduced to schools, teachers and students during the activities of Phase-C were from all three categories, simulations/virtual labs, datasets and remote labs (see also Annex II Table 1). Listed alphabetically per category, these were the following:

Simulations/virtual labs: Acid-Base, Black-body radiation, Bond, Build an atom, Cryptography, Electricity lab, Fishbowl Guppies, Gearsketch, Geogebra, Greenhouse, Impact calculator, Osmosis, PhET-Buoyancy, PhET-Density, PhET-Balancing act, pH scale, Splash, Star in a box;

Datasets: Hypatia, ESA-SOHO archives, iSpyCMS, Sun4all, SalsaJ;

Remote labs: Archimedes, Boole, Faulkes-Telescope, Microscope, Radioactivity, Robotic arm, VISIR.

The activities with teachers and students that practiced and utilized these online labs and related ILSs were linked to various science curriculum domains and in particular to Physics, Astronomy, Technology/Informatics/Electronics, Chemistry, Biology, and Maths. Their classification in terms of subject domain is shown in Figures 5.5 and 5.6, for teacher trainings and activities with students, respectively. Similarly, to previous phases, in Phase-C the majority of occurrences is on Physics and Astronomy. However, it should be noted that during Phase-C an improvement of distribution across subject domains was achieved compared to previous phases. In summary, for teacher trainings the grand majority is on Physics with 77% and Astronomy with 70%, followed by Technology-Informatics-Electronics 13%, Maths 13%, Biology 12% and Chemistry 12%. For student activities the corresponding subject domains are: Physics 73%, Astronomy 23%, Maths 15%, and Technology, Biology, Chemistry of about 1% each or less.

The achieved distribution of subject domains is mainly due to the expertise and the experience of the partners involved and also to some extent because of the schools' and teachers' preferences and demands. It also reflects the core subjects of the science curriculum wherein most commonly teachers find opportunities to utilize online labs in their teaching or to link with interdisciplinary educational activities.

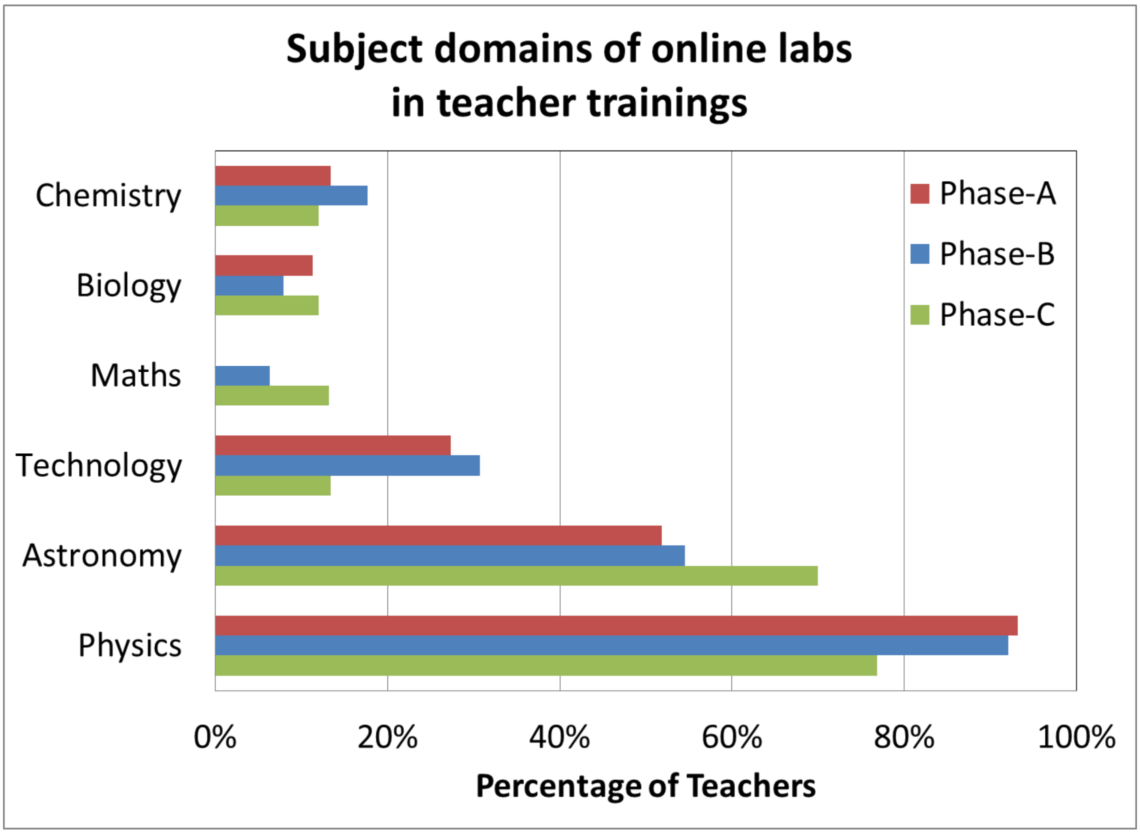


Figure 5.5 Subject domains of online labs demonstrated and practiced in Go-Lab teacher trainings

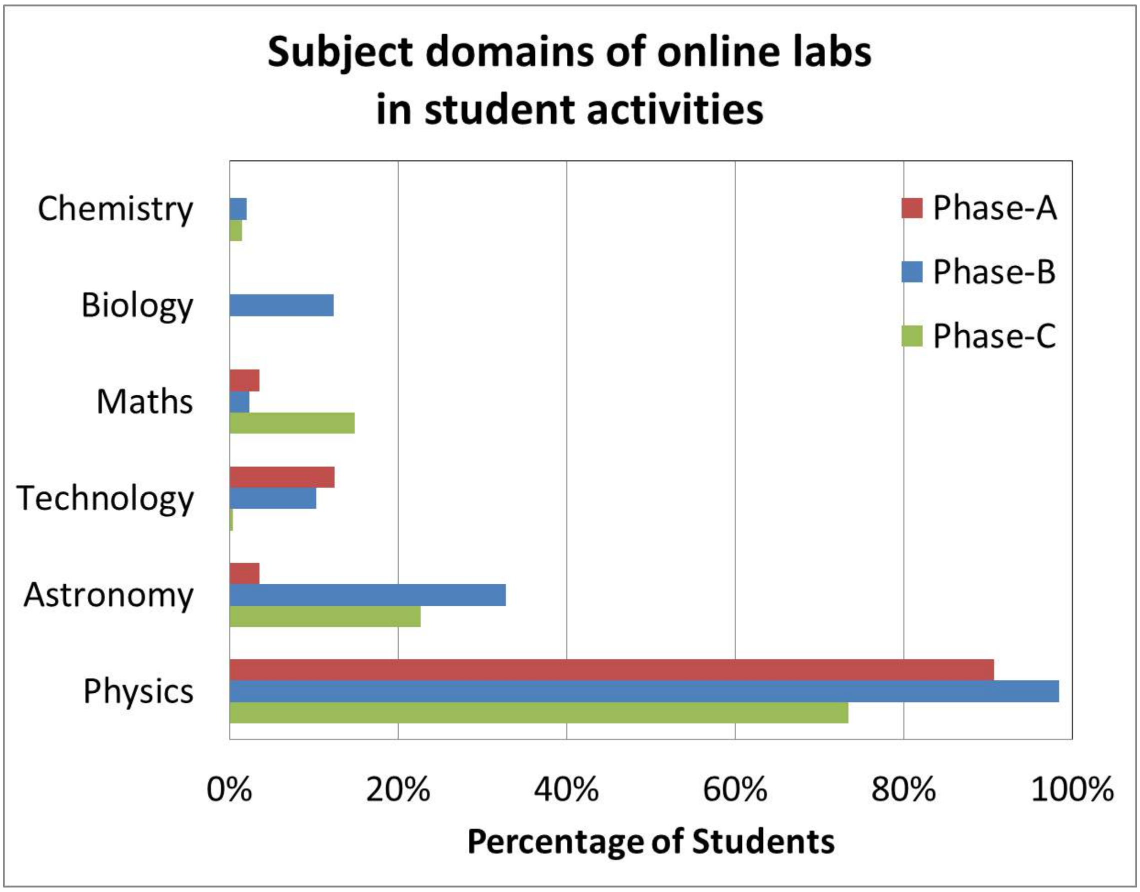


Figure 5.6 Subject domains of online labs utilized Go-Lab student activities organized by partners

5.2. Analysis of usage from system data

The analysis of section 5.2 has been based on the system log data of the Graasp portal which allowed for the application of further qualitative criteria in order to single out the implementation runs in schools.

In Phase-C we had a smooth continuation of the implementation of the project with stable and mature system and with plethora of high quality inquiry activities available in public, shared or private ILSs. During the last year and phase of the project larger number of teachers were producing complete and better ILSs and also actually using them with their students. At the time of writing there are almost 400 ILSs which are published in the golabz.eu repository, with more than 85% of them made by teachers, in various languages and subjects. In addition, there are more than 1000 ILSs which are in constant use but unpublished.

The analysis of the system usage data shows a direct indication of the constant and wide uptake of Go-Lab and the impact of the implementation activities and the related effort that was devoted by the consortium partners as discussed in the previous section. The latter is summarized again in Figures 5.7 and 5.8, which show the cumulative numbers of participation in teacher trainings and student activities after each implementation phase. In the following this section presents the results from the analysis of the system data.

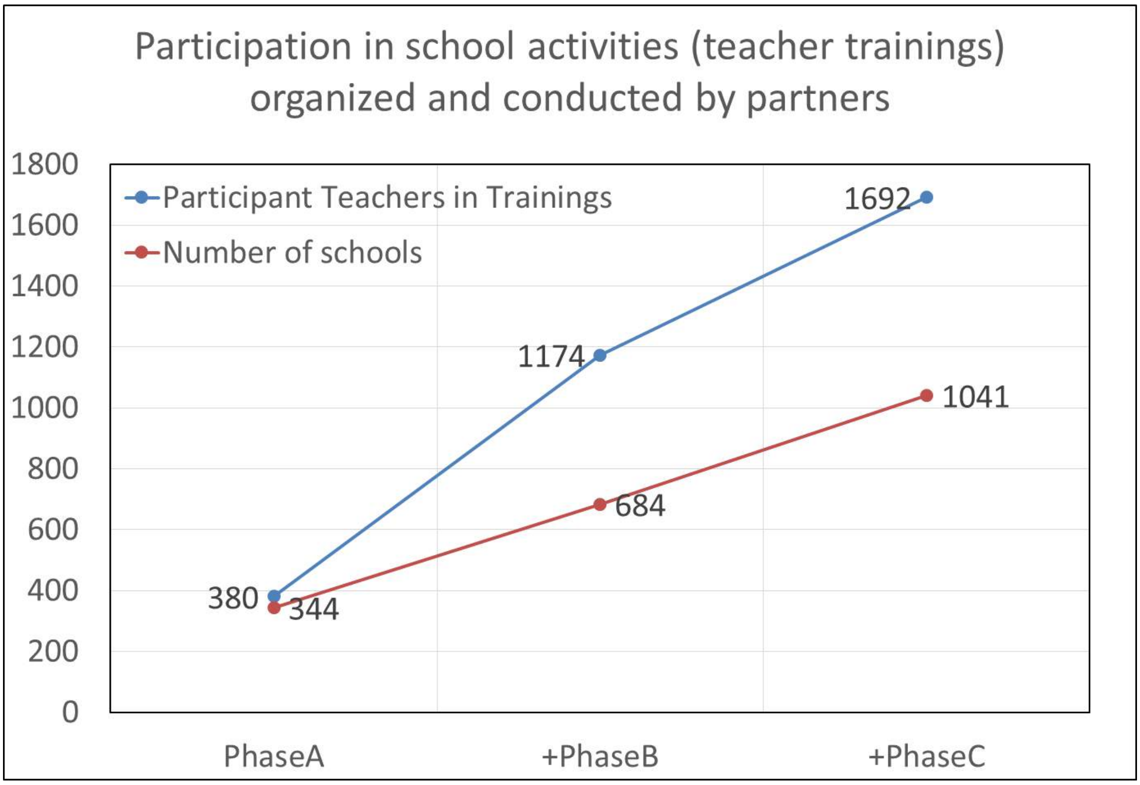


Figure 5.7 Cumulative numbers of participation in teacher training activities organized by partners

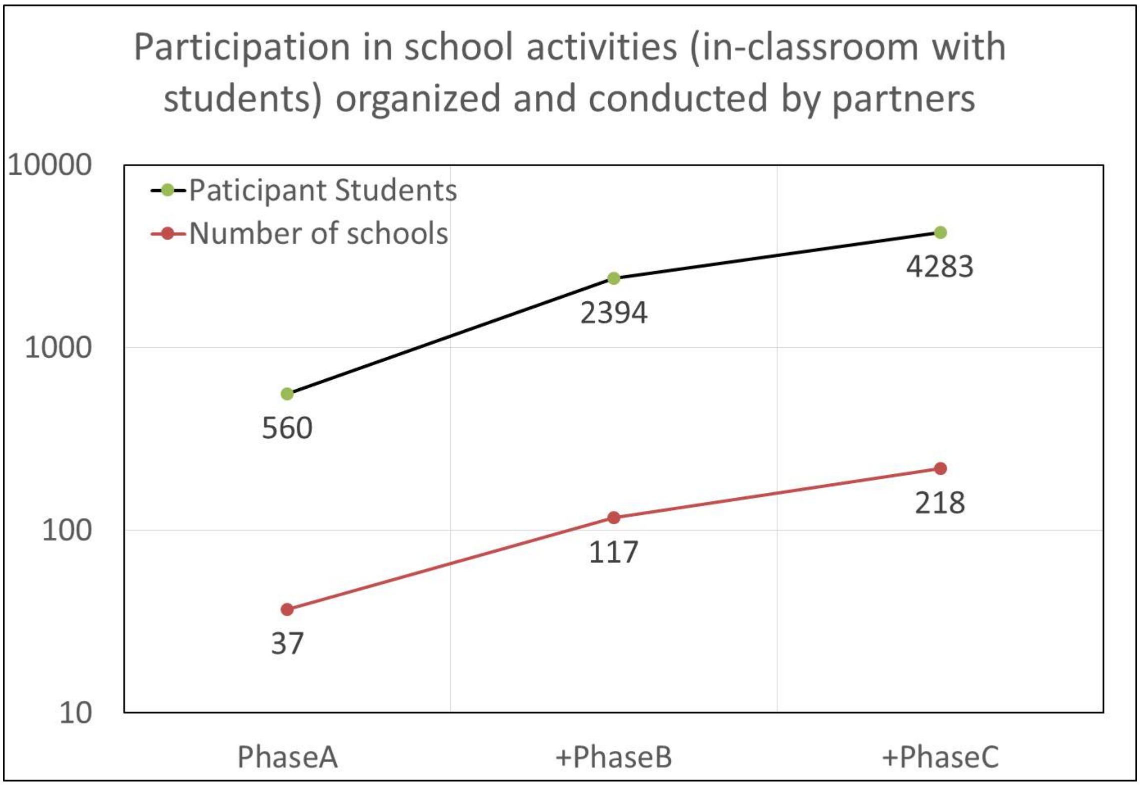


Figure 5.8 Cumulative numbers of participation in student activities organized by partners

5.2.1 Time evolution of usage

The system log data and their thorough analysis offer us an independent and objective way to study the actual usage of the system, its main characteristics, how and when ILSs are created and implemented, how the overall population of users evolve in time etc. In this context, from Oct 2014 and since the migration to the new system until the end of Phase-C (July 2016) 6517 new users registered and created an account in the authoring environment. Of whom 3877 became creators and authors of 1470 ILSs as counted with minimum quality criteria (e.g. ILSs with all inquiry phases according to the proposed Go-Lab inquiry cycle, with at least five standalone student views, etc.). These figures show a more than 100% increase when counted from the start of Phase-C (Oct 2016) as can be seen in Figure 5.9. When compared to the total number of teachers participated in the partner trainings we see that we reached a multiplication factor of 3.85 with respect to number of registered users per trainee, and 2.29 with respect to content authors per trainee. This reflects the fact that more experienced and advanced teachers were training and tutoring their less experienced colleagues, which is in line with what national coordinators and partners had observed during their interactions with participants at the training workshops.

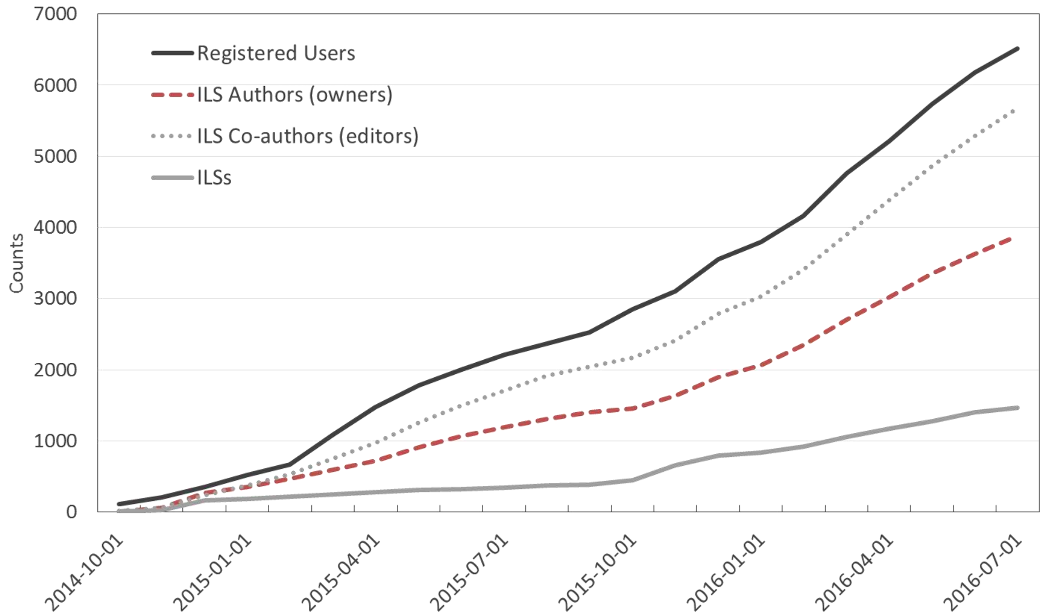


Figure 5.9 Time evolution of registered users, authors and editors, and ILSs created in the authoring environment.

Figure 5.10 shows more qualitative parameters and how they evolved through time for the last two implementation phases. We observed that the number of registered users that correspond to an author of inquiry content quickly improved since the start of trainings from Phase-B, Oct 2014, and stabilized to an average value of 1.68. This means that on average about 2 out of 3 users they actively used the authoring environment and the offered tools to adapt or create their own ILSs. In the same figure, the curve of authors per ILS shows a more seasonal behaviour which coincides with the periods that schools and teachers are in duty. It had a variation between about 2 and 4, with an overall average value of 2.64. This reflects the fact that teachers were gradually and actually sharing content with 2 or more other users or/and worked collaboratively with colleagues in the design and development of their ILSs.

In addition to above, a more significant qualitative change in the behaviour of users and how the system was utilized in practice is shown with the curve “standalone viewers per author”. The term standalone viewer refers technically to the action of viewing an ILS by students that access it with nicknames or passwords given by their teacher. As can be seen there was a clear and distinctive rise after summer 2015 and since the start of the corresponding school year that spanned the last implementation Phase-C. This constant increase shows clearly that progressively more and more teachers are utilizing their ILSs with their students. At the end of the phase it reached the value of 9.4. Taking into account that on average a typical school classroom consists of 20 to 25 students this means that on average about 2 students are sharing a PC to login and access the ILS taught. This is consistent with observations from national coordinators and partners and in particular from those who organized and implemented themselves activities with students in school classroom settings. The summative reported numbers (see Table 5.1) for the activities that conducted by partners are 4283 students from 218 schools, which corresponds to 19.6 students per classroom.

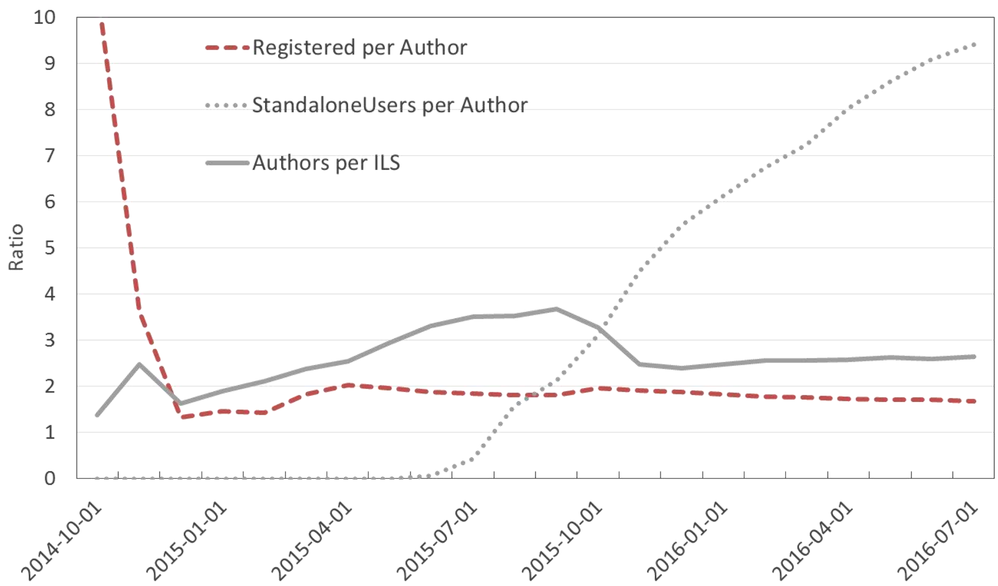


Figure 5.10 Time evolution of the number of registered users per author, standalone viewers and authors per ILS.

The abovementioned quantitative and qualitative change in the behaviour of users and the overall achieved usage of the system is a combination of several factors, among others: 1. maturity and proficiency of users; 2. consequent creation of a significant critical mass of teachers who produced in abundance a large variety of high quality ILSs in various languages, subjects and complexity levels; 3. abundance and variety of online labs and supportive apps in the portal; 4. technical improvements that made the system and the authoring environment more user-friendly.

The final effect is apparent in Figure 5.11 that shows the number of users that access and work in the authoring environment daily. At the end of Phase-C 200 users per day are utilizing the services and tools of the system to design and create inquiry lessons with online labs, to share or co-author content and to deliver it to school classrooms throughout Europe and beyond.

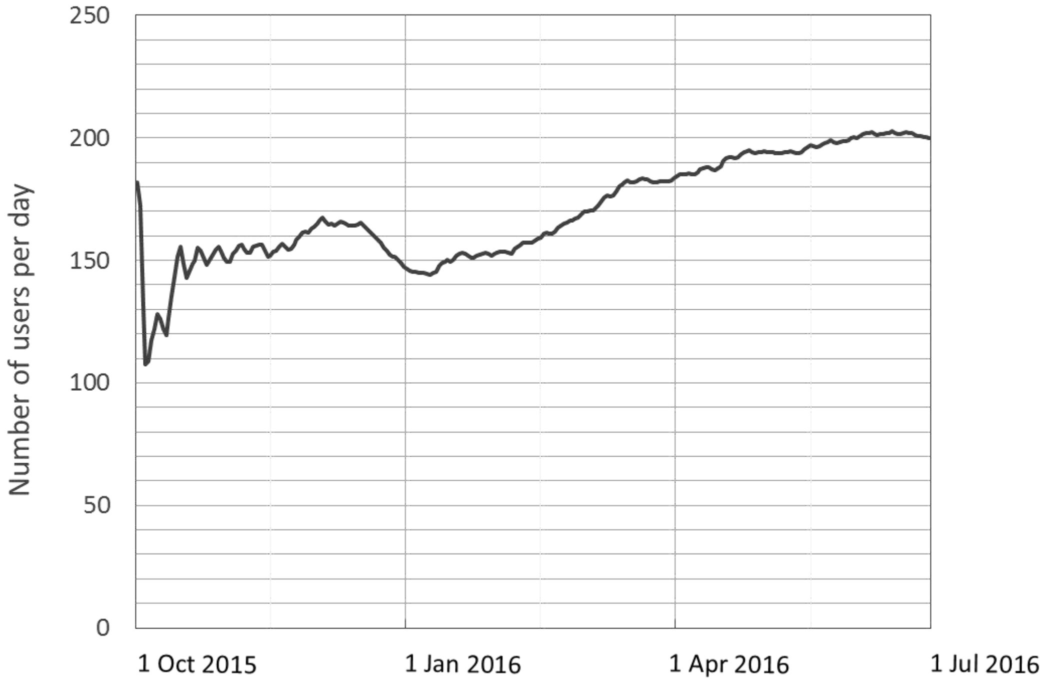
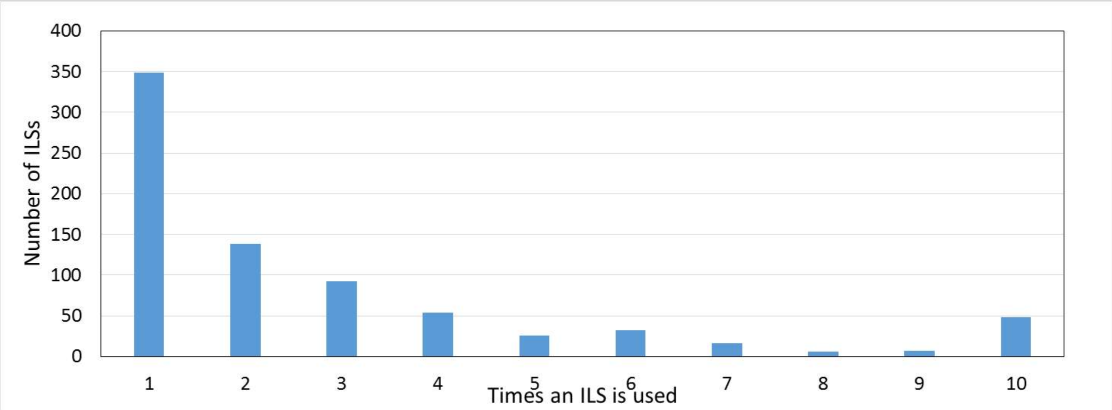


Figure 5.11 Number of users per day in the authoring environment during the last implementation phase of the project.

5.2.2 Usage of inquiry learning spaces in schools

The system log data (Graasp) gives us also the opportunity to analyse and estimate the overall usage of ILSs, time duration, repetition rate etc. The analysis was based on 768 ILSs that passed a set of strict quality criteria (e.g. threshold value of standalone viewers of more than 10, usage of all phases of inquiry, minimum time of ILS usage of at least 15 mins, etc.) that were applied to the raw database.

The distribution of the selected ILSs as a function of how many times they were used (in settings of at least 10 standalone viewers, which correspond to 10 connected PCs or equivalently to at least 20 students) is shown in Figure 5.12. We observe that the ILSs are implemented with on average about 50% of cases are a single time, about 30% are 2-3 times, about 11% are 4-6 times, about 8% are more than 7 times. On average this corresponds to an average repetition rate of 2.8 times that an ILS is implemented. In total these ILSs were implemented with 21420 standalone viewers which roughly correspond to more than 40000 actual students. It should be noted that these estimates are on the conservative side if we take into consideration the fact that in many instances school classrooms were equipped with less PCs or equivalently had a higher ratio of students per connected PC.



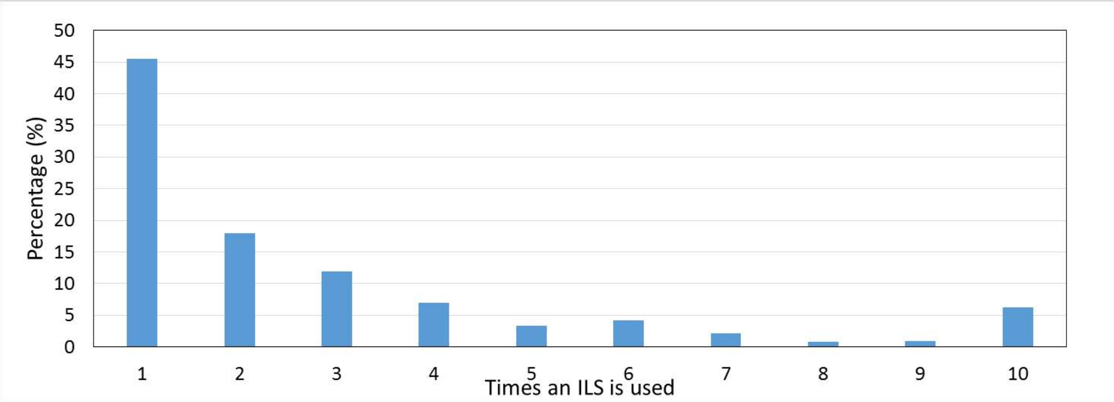


Figure 5.12 (Top) Number of ILSs versus how many times were used in classroom settings of at least 10 PCs which correspond to about 20 actual students. (Bottom) Percentage of ILSs versus how many times were used. (Note: last bin refers to values more than 10)

The results of the analysis of data with respect to duration of usage of an ILS is shown in Figure 5.13 below. As can be seen from the upper curve overall in about 60% of the cases the duration of usage of an ILS is for about 43 mins. The long tail is understood due to cases where an ILS is partially implemented during classroom hours and then its usage were continued by students as homework, or for added assignments or in extra-curriculum activities. If one considers only in-school hours, typically from 8:00 until 15:00, then about 44% of the cases fall in this category as shown in the lower curve of the graph. This is well consistent with data from surveys of teachers about how they used Go-Lab. It should be also noted that both curves are reproduced by power law distribution functions. This is typically expected to describe a dynamic system of large size of e.g. physical, biological or social nature.

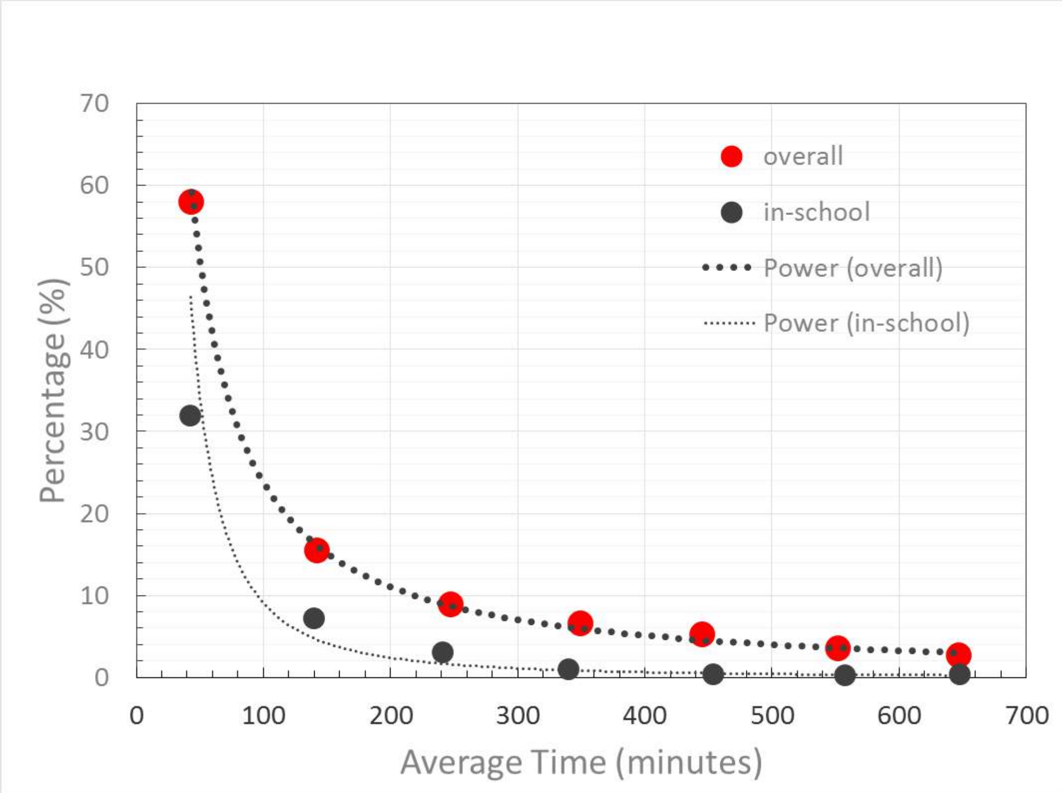


Figure 5.13 Distribution of average duration time an ILS is implemented.

5.3. Summary and key indicators of the school pilot phases

In summary, throughout the implementation phases of the project national coordinators and partners organized and conducted series of implementation activities with teachers and students reaching a large audience across countries. Following an overall implementation plan and inclusive strategy engaged schools, teachers and students in the Go-Lab approach of science teaching and learning. A constant and wide uptake of Go-Lab was realized as shown by the submitted reports of activities and the analysis of the data. Below are listed the main key quantitative and qualitative indicators achieved.

- 1692 teachers from 1041 schools attended the training workshops that partners organized;
- 4283 students from 218 schools participated in the activities that partners organized;
- 6517 new users registered since Oct 2014 to July 2016;
- 3877 became creators and authors of more than 1470 ILSs;
- Achieved multiplication factors of 3.85 with respect to number of registered users per trainee, 2.29 with respect to content authors per trainee
- 2 out of 3 users they actively used the authoring environment and the offered tools to adapt or create their own ILSs;
- Users sharing content with on average 2.64 other users or/and worked collaboratively with colleagues in the design and development of their ILSs;
- 200 users per day are utilizing the services and tools of the system;
- More than 768 ILSs of high quality criteria implemented in schools (44% of cases during in-school hours), with an average repetition rate of 2.8 times, reaching more than 40000 students

6. Conclusions

Go-Lab as a project - and the its specific system to create and implement ILSs in specific - have proven its tremendous potential for further use, having introduced a new, engaging and attractive way as well as innovative tools and resources for science teaching. However, the accomplishments of the project did not only depend on the technical aspects or the existence of a wide repository of ILSs, labs and apps, but to a great extent also on the support and training offered and given to teachers and users across Europe. Because of the multiple opportunities offered by the consortium and the national coordinators for teachers to receive the support they needed in order to feel confident in exploring the proposed Go-lab approach and test it in their classroom with their students, the project was able to accomplish and exceed the set goals of teachers and users trained and pilots implemented at school level.

This report has shown that teachers - for the most part - did appreciate and did need especially the direct and physical support of Go-Lab partners to learn about meaningful ways to make use of the Go-lab system and IBSE methodology and to successfully implement ILSs in their school and with their students. Furthermore, the designed and developed a wide-ranging support methodology that offered the necessary online and offline tools to teachers as well as national coordinators throughout the piloting sessions has proven to be effective with measurable results. The combination of engagement, training, support, recognition and community aspects and activities has been successful in engaging, motivating teachers and in many cases has led to a cascade effect where teachers were training their colleagues and peers in the use of the system.

This is one of the main reasons that the proposed sustainability strategy for the future development of the Go-Lab community and users is based on the idea of the expansion of the summer schools (as the "Go-Lab Academy") as proposed and described in Deliverable 9.6. The data has shown that the training of summer schools has achieved the best results in terms of creation and implementation of ILSs.

Certainly, the factors contributing to the different usage of the Go-Lab system are influenced by a variety of different sources. The conclusions that can be drawn from the analysis presented above, and by matching the different support activities with the behaviour of the users are the following:

- Dissemination events were certainly an important trigger for users to visits the Go-Lab portal and become explorers;
- Engagement activities, such as the visionary and practice reflection workshops motivated the first level of engagement (users exploring the portal and registering in Graasp) and in many occasions triggered the next level of involvement (users using existing resources);
- Training events – especially the summer schools - were the most effective mean to promote users to the next level (Adopter/adapter of the resources);
- The continuous support provided by national coordinators and by the pedagogical and technical team were the key aspect for the emergence of the higher level of engagement, the creation and authoring of new ILSs.

Consequently, we believe that the Go-Lab support methodology has the potential to become a self-sustaining help desk where teachers can find help from the technical team, the lab owners, ILS designers and most important from their peers – even after the project's official conclusion.

Taking into account that training teachers on the use of the system requires a hibernation time for practicing, reflecting and adaptation to the curricula, we have to note that the presented numbers have exceeded our expectations by far.

In previous deliverables the expressed aim of the work in the framework of WP6 and WP7 was defined as follows:

A. To develop a mechanism that supports the large scale implementation effort of the Go-Lab consortium to implement the project in at least 1000 schools in Europe
B. To develop a mechanism that monitors the process of the community development, and that will help the consortium to realize how the users are interacting with the systems, to understand their needs and their problems in order to provide personalized support.

During all phases of the large scale implementation more than 1000 schools and almost 1700 teachers reacted to the calls for participation to Go-Lab activities. Nearly 3900 Graasp users have created new or used existing ILSs. For every teacher trained, almost 4 other trainers or teachers have registered in Graasp and explored the system, which demonstrates not only the technical pedigree of the system but also the potential of the applied support mechanism to engage and support such a large community.

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