

# Go-Lab

## Global Online Science Labs for Inquiry Learning at School

Collaborative Project in European Union's Seventh Framework Programme  
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### Deliverable D4.8

## Releases of the Learning Analytics, Scaffolding Services, and Add-on Services - Final

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## ***Executive Summary***

This deliverable describes the final releases of learning analytics, scaffolding, and add-on services of Go-Lab, following the final specification reported in D4.6 (M33). It also considers users' feedback and reviewers' evaluation to the initial release in D4.4 (M24).

This deliverable consists of two major parts: (i) the learning analytics and scaffolding services and (ii) the add-on services which are specified in two components, i.e. the booking system and the tutoring platform.

The learning analytics and scaffolding services consist of a rich backend and several options to develop new learning analytics apps according to the specified infrastructure and architecture. To support the two main stakeholders of learning analytics in Go-Lab, namely teachers and learners, a teacher dashboard and several apps, e.g., to support learners' reflection, will be presented in this deliverable. Participatory design activities, particularly framed by the Go-Lab Summer School 2015, have been used to evaluate initial versions of the learning analytics apps to gather useful feedback aligned to the stakeholders.

The booking system (<http://www.golabz.eu/>) offers Go-Lab remote labs an appropriate booking service using a calendar managed by lab owners. It consists of the front-end user interfaces for both lab owners and teachers, as well as the backend services to validate the booking information through the Go-Lab Smart Gateway. The tutoring platform (<http://tutoring.golabz.eu/>) helps build up a virtual community where teachers could share their expertise in inquiry learning with online labs and help each other grow their teaching skills. Both of them provide the add-on services for the Go-Lab Portal.

The releases of LA, scaffolding services, and add-on services facilitate a technical framework with additional indispensable services for the Go-Lab Portal (cf. D5.6). They are the collaboration research results between WP4 and WP5, taking into account the feedback from WP3.

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## 1 Introduction

This deliverable reports on the final releases of learning analytics, scaffolding, and add-on services. To support readability and keep consistency, we structure the deliverable in two parts as in previous deliverables: (i) learning analytics, scaffolding, and (ii) add-on services.

This deliverable describes concrete agents, services and apps, and their respective implementations in line with the final specifications defined in D4.6. The first-hand teachers' feedback retrieved from Work Package 3 has also been taken into account. To avoid duplication, the final specifications are only briefly mentioned to provide context. We recommend the readers who want to have a complete overview to read the final specifications as well.

System links are listed below:

- The booking system is accessible and integrated in the Go-Lab Portal at <http://www.golabz.eu/>.
- The tutoring platform is accessible at <http://tutoring.golabz.eu/>.

## 2 Learning analytics and scaffolding services

### 2.1 Introduction to learning analytics and scaffolding services

Siemens (2012) defines learning analytics as “the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimising learning and the environments in which it occurs”. To achieve these goals, learning analytics brings together different fields, i.e. business intelligence, web analytics, educational data mining, and recommender systems (Ferguson, 2012). Methods comprise (1) content analysis of produced artefacts by learners (such as concept maps (de Jong et al., 2010; Hoppe et al., 2012; Clariana et al., 2013) and texts (De Wever et al., 2006; Liddo et al., 2011; Southavilay et al., 2013)), (2) learner behaviour analysis (Zaiane & Luo, 2001; Facca & Lanzi, 2005; Duval, 2011) and (3) social network analysis (Laat et al., 2007; Zhang et al., 2007; Harrer et al., 2007). A major challenge, also for the Go-Lab project, is to combine these approaches in a flexible infrastructure in order to achieve productive synergy (Suthers et al., 2013).

The Go-Lab Portal offering various kinds of inquiry-based learning activities generates many types of data, including traces of interaction with the system and results of the learning process. The learning analytics services make use of such data to provide analytical information for the Go-Lab Portal (D5.2) and add-on services (section 3) in order to foster awareness and to create individual scaffolds for students as well as information for teachers, thus supporting the monitoring of learning activities and better informed decision making.

The focus of the analytics and scaffolding services in Go-Lab is on interaction and content analysis, since social relations are not explicit in the Go-Lab Portal. Interaction analysis is based on the action logs collected in the LA Backend through a specific tracking agent called AngeLA (Vozniuk et al., 2014). In turn, content analysis refers to learner-generated artefacts (e.g., concept maps or hypotheses) that are accessible through the ILS's data repository (the "vault").

For a better overview and distinction of the Go-Lab learning analytics services it is appropriate to distinguish the following three levels (outside-in): The outermost perspective addresses the portal as a whole. On this level, the learning analytics services can help teachers to find appropriate resources, for example, through the recommendation of apps, labs and ILS templates. Technically this can be supported by web analytics techniques. The second level is related to single inquiry learning spaces (ILS). Support on this level includes monitoring support for teachers, providing a visual account of the students' activities in an ongoing session. Similar information can be given to students to support reflection. This level also includes the analysis of action log protocols comprised of time stamped events like the access of a resource or app usage. The innermost level refers to the analysis of the student actions inside particular apps and the thereby produced data (user actions or learner-generated content). This is an important source of student scaffolding, yet it depends on the internal specification of the app.

Scaffolding mechanisms assist learners in tasks that they cannot solve without guidance. Scaffolding is based on previous analysis and modelling of learner behaviour. Typical scaffolding mechanisms are immediate feedback (e.g., with example recommendations) or the provision of more context information in an app. Scaffolding services for learners rely on information about the labs, their users, and corresponding user activities as well as the subject domain of the lab. Therefore, scaffolding apps are dependent on the lab metadata scheme developed in WP2 as well as on the smart device and the gateway for remote labs (see D4.1).

For all types of learning analytics it is beneficial that the results be accessible in the current learning context and not only in separate spaces (Harrer & Göhnert, 2015). This facilitates the usage of the learning analytics results as they are offered in the context of the learning and teaching process and thus can also be connected more easily. This means that there is not only the challenge to define and implement appropriate learning analytics tools, but also the challenge to integrate these with the learning and authoring platforms. One possible approach is to embed the results of external analysis tools (of a possibly more general type) into the learning platforms to make the results of the analysis process directly accessible in the context of the platform (Vozniuk et al., 2015). Technical solutions and architectural models for this approach have been developed by (Göhnert et al., 2014), (Manske et al., 2014) and (Vozniuk et al., 2013), the latter two explicitly contextualised in the framework of Go-Lab.

## ***2.2 Stakeholders and their Information Needs***

Based on the requirements collected from the user scenarios for learning analytics as well as on participatory design activities (cf. D4.6, Section 2.8), a matrix of the functions that are provided to the different stakeholders and target groups of Go-Lab through learning analytics has been derived. Particularly the rendering of learners' artefacts is not a dedicated task for learning analytics. It is closely coupled to front-end development of Inquiry Learning Apps (D5.6) and the portal, thus situated in WP5. However, the rendering of artefacts might be based on the infrastructure developed in WP4 as part of the final release in this deliverable. The main focus for the application of analytical methods is on the aggregation of artefacts or participation-related representations and visualisations. The following matrix gives an overview over the different stakeholders and the learning analytics related functions we provide in order to support them in their roles.

Functions	Target Groups			
	researchers	teachers	students	lab-owners
<b>participation</b>				
- global	+	+	+	+
- phases	+	+	+	+
- tools	+	+	+	+
trajectories	+	+	+	-
norms	+	+	+	-
intra-tool behaviour	*	*		-
<b>artefacts</b>				
- render	-	*	*	-
- compare	-	*		-
- aggregation	-	*	*	-
- evolution	-	*		-
- consistency	-	*	*	-

A plus sign in the table indicates generally available tools or solutions for providing a specific function on a domain-, app-, or artefact-independent way. E.g., the Action Statistics app that shows global participation of students based on action logs is functioning independently of specific apps. A star indicates that we provide solutions only for specific cases or apps. Exemplary, intra-tool behaviour is a function that will be very restricted for analytics if defined on a general basis. Such common denominator of functionality might not suit the requirements of personalisation and will probably not be very specific. The Concept Map Aggregation together with the Concept Mapper demonstrate the interoperability on an app-specific level: the target representation - namely the graph showing the aggregated concept map - is consistent with the source representation of the concept mapper, thus giving detailed information and indications of the knowledge states of a learning group. A more general approach for cross-artefact analytics is used in the ConceptCloud app (cf. 2.3.6) which processes text-based artefact representations such as hypotheses, concept maps, wikis, or other texts that are stored in the vault. The app aggregates concepts that are extracted from the text-based artefacts to a single representation. Sacrificing the relations between the concepts serves the purpose of homogenising the resulting representation, which demonstrates the trade-off between general and specific solutions. A minus indicates that we won't provide solutions at all, e.g., lab-owners shouldn't be able to view artefacts of students, as this would restrict their privacy and probably will not give any useful insights to the lab-owner.

### 2.2.1 Students

Students produce learning objects inside the online learning environment of the Go-Lab Portal. The apps that are used for the creation of the learning objects also render them in appropriate representations, while enabling to revisit the state at any time. Thus, the main focus for a student should be put on supporting reflection on specific artefacts and learning processes, based on participation, mainly indicated through action logging. An individual trajectory and the participation in phases is presented in the app "My Learning Process" (2.3.5), while

the observed as well as the expected (teacher-defined norms) participation is shown in the reflection tool (2.3.1).

### **2.2.2 Teachers**

A main task for teachers is the supervision of student activities in the online learning environment as well as the revision of the learner-generated artefacts. The plain rendering of artefacts of a certain type is not a task dedicated to learning analytics and thus not part of this deliverable. The teacher is always able to view the artefacts with the help of the production tools in their specific rendering engines in the review mode (cf. D5.6). Participation on global and on tool level can be visualised with the Action Statistics app (2.3.3), while the participation and the trajectories of students can be seen in the Timeline app (2.3.4). These apps provide an overview of all students that are using the related ILS and are suited to be included in a dashboard (cf. 2.4).

### **2.2.3 Lab-Owners**

Lab-owners have a focused view on their own resources and how they are accessed. This is abstracted from an individual level and displays usage data, such as resource access, particularly the lab usage, on a low granularity. To be consistent with the learning analytics architecture, this will be provided through an app (see 2.3.11) in a similar way as other learning analytics apps. Still, here it is served in a different target platform, namely the Golabz repository, which is the central point for lab-owners. The same applies for app-owners/creators who have published their application in Golabz.

### **2.2.4 Go-Lab Consortium**

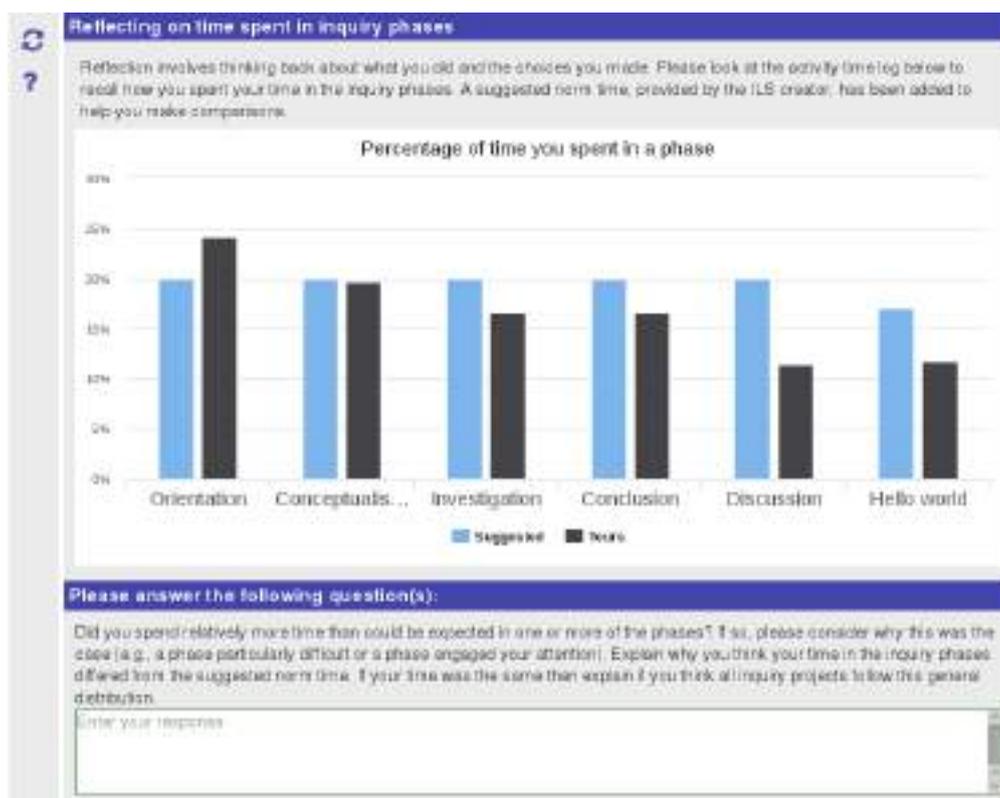
Researchers of the Go-Lab Consortium also are provided with means of learning analytics on a lower level, particularly with access to the Data Warehouse API of the Go-Lab Learning Analytics server (as specified in D4.6). It offers high-level indicators for the analysis of learner trajectories and representations of learning process models, such as calculating measurements for deviations of learners from the specified inquiry model (Manske, Chounta, Rodriguez Triana, Gillet, & Hoppe, 2015). Besides the indicators, it grants access to action logs and provides an API for aggregating action logs or to create anonymised data sets for further analysis. To provide sustainability of the infrastructure and to ease up the development of new learning analytics apps based on the delivered infrastructure, we also deliver a template for learning analytics apps. The so-called "Starter App" is an already integrated app, particularly using the Go-Lab integration libraries for action logging, notifications, storage, etc.

## ***2.3 Overview of learning analytics apps***

Based on the stakeholder and their information needs, several learning analytics apps have been developed. The following section describes each of the delivered apps included in the final release. All components are based on the final specification (D4.6), using different parts of the learning analytics infrastructure such as agents, services, or OpenSocial for data gathering and processing.

### 2.3.1 Reflection Tool - Time Spent

<b>Keywords</b>	Reflection, time spent in ILS phases.
<b>Main Contact(s)</b>	Anjo Anjewierden, University of Twente, a.anjewierden@utwente.nl
<b>Summary</b>	The time spent reflection tool shows the time students spent in ILS phases and allows them to reflect on how they used an ILS.
<b>Stakeholder(s)</b>	Teacher (for configuration), student (use).
<b>Architectural Approach</b>	OpenSocial App, LA service, and LA agents.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Logging services, possibly data warehouse.
<b>LA agents used</b>	Reflection agent.
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	<a href="http://go-lab.gw.utwente.nl/production/reflect/build/reflect1.xml">http://go-lab.gw.utwente.nl/production/reflect/build/reflect1.xml</a>
<b>Demo URL</b>	<a href="http://go-lab.gw.utwente.nl/production/reflect/build/reflect1.html">http://go-lab.gw.utwente.nl/production/reflect/build/reflect1.html</a>



**Figure 1.** The reflection tool provides an overview about the time spent in ILS phases.

**Description.** The time spent reflection tool is an app included in an ILS that allows students to reflect on where they spent their time in an ILS. The teacher

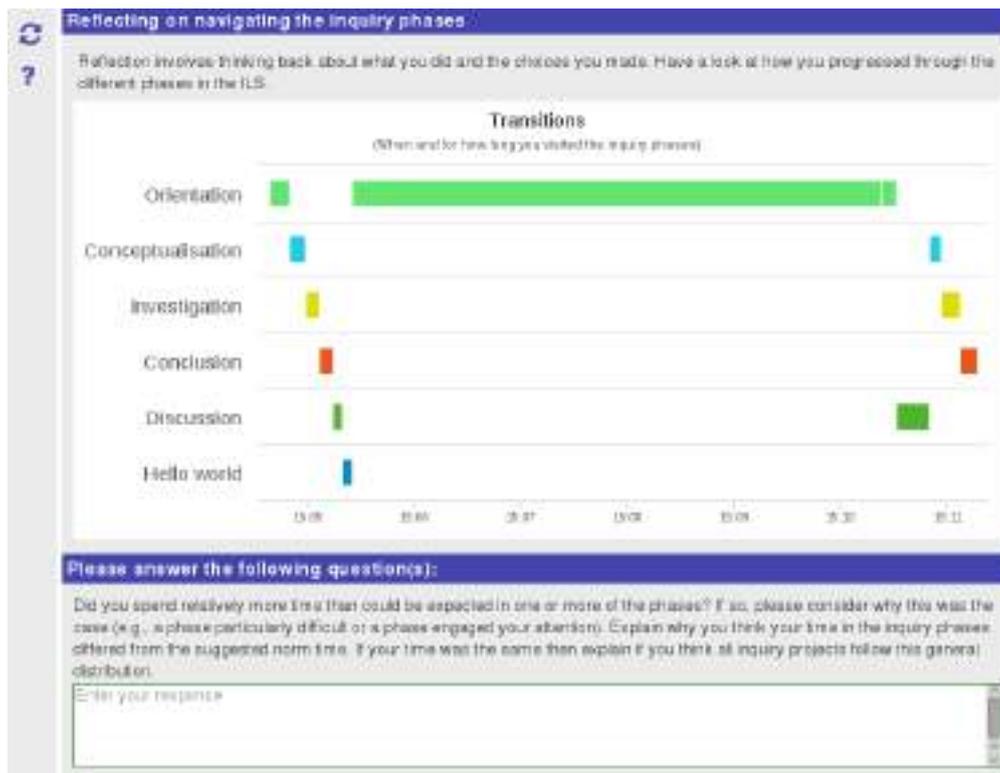
can add a norm for the percentage in the tool's configuration (e.g., 20% in the Orientation phase). The teacher can also include several reflection questions the student can fill in. Figure 1 shows both aspects of the app, namely the statistics in the upper part and the reflection question in the lower one.

The implementation is based on an agent listening for action logs per connected student. The agent scans the action logs for action in ILS phases and accumulates these.

### 2.3.2 Reflection Tool - Transitions

<b>Keywords</b>	Reflection, transitions between ILS phases.
<b>Main Contact(s)</b>	Anjo Anjewierden, University of Twente, a.a.anjewierden@utwente.nl
<b>Summary</b>	The transition reflection tool shows a detailed graph of how students have navigated through the ILS.
<b>Stakeholder(s)</b>	Teacher (for configuration), student (use).
<b>Architectural Approach</b>	OpenSocial App, LA service and LA agents.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Logging services, possibly data warehouse.
<b>LA agents used</b>	Reflection agent.
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	<a href="http://go-lab.gw.utwente.nl/production/reflect/build/reflect2.xml">http://go-lab.gw.utwente.nl/production/reflect/build/reflect2.xml</a>
<b>Demo URL</b>	<a href="http://go-lab.gw.utwente.nl/production/reflect/build/reflect2.html">http://go-lab.gw.utwente.nl/production/reflect/build/reflect2.html</a>

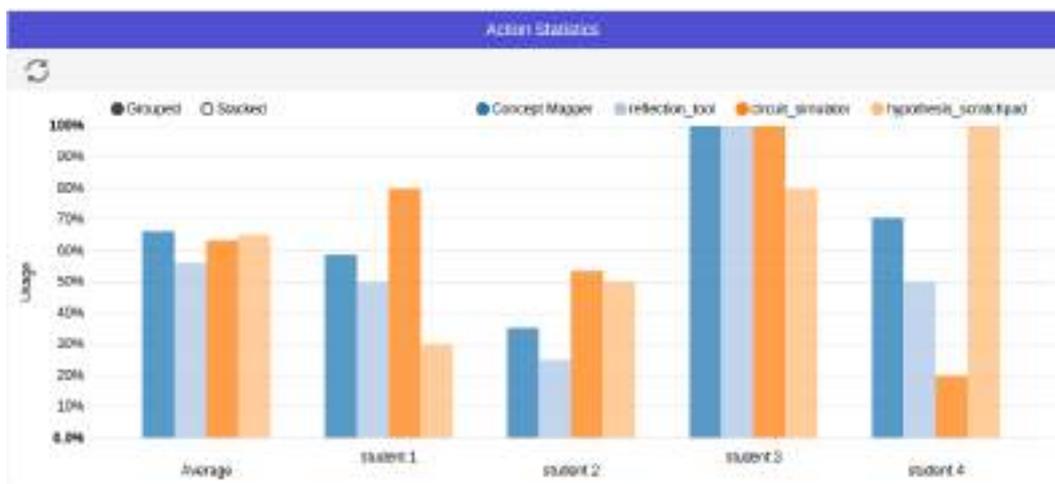
**Description.** The transitions reflection tool is an app included in an ILS that allows students to reflect on how they navigated through the various phases in an ILS. The teacher can also include several reflection questions, for example "Did you frequently go back to a previous phase? If so, why?".



**Figure 2. The reflection tool provides an overview of the transitions between phases.**

### 2.3.3 Action Statistics

<b>Keywords</b>	User Activity, Global Participation, Participation in Tools
<b>Main Contact(s)</b>	Sven Manske, University of Duisburg-Essen, manske@collide.info
<b>Summary</b>	The Action Statistics app displays the number of actions per user and per app.
<b>Stakeholder(s)</b>	Teacher (all students activities), student (own activities and ILS-average).
<b>Architectural Approach</b>	OpenSocial App and LA service.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Action Log Aggregation Service.
<b>LA agents used</b>	-
<b>Golabz URL</b>	<a href="http://www.golabz.eu/apps/action-statistics">http://www.golabz.eu/apps/action-statistics</a>
<b>App/Gadget URL</b>	<a href="http://golab.collide.info/client/tools/action_statistics_tool_usage/gadget.xml">http://golab.collide.info/client/tools/action_statistics_tool_usage/gadget.xml</a>
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/action_statistics_tool_usage/index.html">http://golab.collide.info/client/tools/action_statistics_tool_usage/index.html</a>

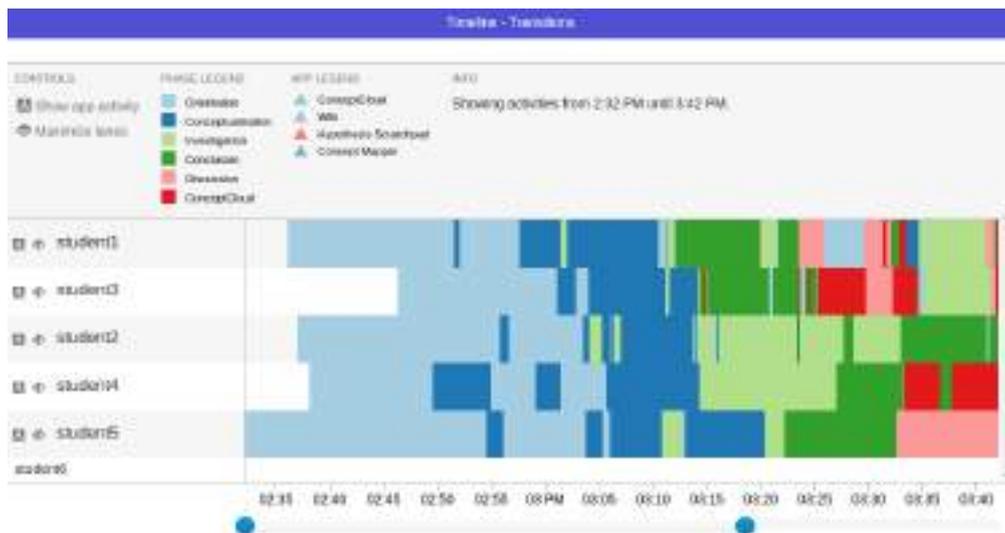


**Figure 3. The Action Statistics app indicates participation on an ILS and tool level.**

**Description** The Action Statistics app indicates both the global participation and the participation in tools for learners. It has different views for students and teachers. The teacher is able to get an overview about the (relative) amount of activity per app in the ILS - she will see a bar for each user of the ILS and each app he or she used. The student view consists only of two users - him or herself and the average of the ILS as a comparative indicator, to reflect on the relative level of activity in each app. The number of actions that are common for a session is quite different from app to app due to the different logging semantics and operators each app offers. Therefore, it displays the relative number of actions normalised by the maximum that occurs in the ILS. A teacher might use this as an indicator for relatively high or low activity of a student in an app compared either to other students or the average.

### 2.3.4 Timeline

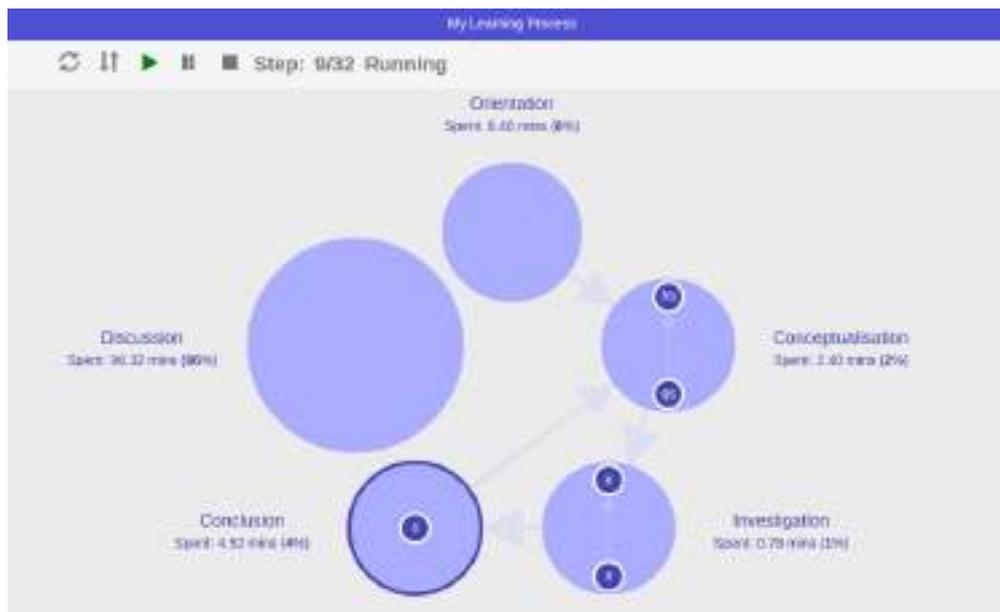
<b>Keywords</b>	User Activity, Participation in Phases, Monitoring
<b>Main Contact(s)</b>	Sven Manske, University of Duisburg-Essen, manske@collide.info
<b>Summary</b>	The Timeline app displays the number of actions per user and per app.
<b>Stakeholder(s)</b>	Teachers
<b>Architectural Approach</b>	OpenSocial App, LA agents.
<b>Mode of execution</b>	real-time.
<b>LA services used</b>	Log Retrieval Service.
<b>LA agents used</b>	Notification Agent, real-time-Aggregation Agent.
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	<a href="http://golab.collide.info/client/tools/activity_statistics/gadget.xml">http://golab.collide.info/client/tools/activity_statistics/gadget.xml</a>
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/activity_statistics/">http://golab.collide.info/client/tools/activity_statistics/</a>



**Figure 4.** The Timeline app shows the subsequent phases each student visits. The visualisation is updated in real-time.

**Description** The Timeline app displays for each student a consecutive sequence of phase visits over time. The updates of the timeline are in real-time, thus enabling monitoring of the activities, particularly deviations, and “out-of-order”-behaviour of the students. This could be, for example, a repetition in the sequence of inquiry phases visited by a learner (Manske, Chounta, et al., 2015). In contrast to the reflection tool for the transitions, this tool focuses on a monitoring perspective displaying updates of the data in real-time. Activities that are used as an indicator for the transitions between phases are action logs of the apps in each phase, particularly logs that indicate a phase change.

On the technical side, it uses real-time updates of the client, calculating the deltas for the visualisation to be updated and send through the notification channel of the LA Server. To enable ex-post analysis or a post-review of the activities on the part of the teacher, it is possible to select and display previous sessions. To minimise the amount of data to be displayed in a monitoring dashboard, the app includes optional heuristics to detect the last session and only visualise its data.



**Figure 5. My Learning Process shows the transitions between apps and phases including the timings in phases.**

### 2.3.5 My Learning Process

<b>Keywords</b>	User Activity, Self-Monitoring and Reflection, Learning Process
<b>Main Contact(s)</b>	Sven Manske, University of Duisburg-Essen, manske@collide.info
<b>Summary</b>	My Learning Process displays a representation of the individual learning path (phases, timings and apps) of the learner.
<b>Stakeholder(s)</b>	Student.
<b>Architectural Approach</b>	OpenSocial App and LA service.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Learning Process Model Generator
<b>LA agents used</b>	-
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	<a href="http://golab.collide.info/client/tools/lpmg_app/gadget.xml">http://golab.collide.info/client/tools/lpmg_app/gadget.xml</a>
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/lpmg_app/">http://golab.collide.info/client/tools/lpmg_app/</a>

**Description** My Learning Process targets students in order to reflect on their own learning process. It displays a representation of their phase visits, with the timing per phase and the apps used in each phase, in a way that is aligned to the model of the inquiry cycle. The student might discover deviations from this recommended model in the representation, such as repetitions or cycles (going

back to a previous phase and using an app). The size of the phase nodes in the representation also give an indicator of the time spent (see figure 5).

The LA server provides a service using the Data Warehouse API to retrieve the data model of the learning process. Each learning process model is a graph with connections between app nodes and phase nodes. The edges are extracted from the chronology of consecutive events.

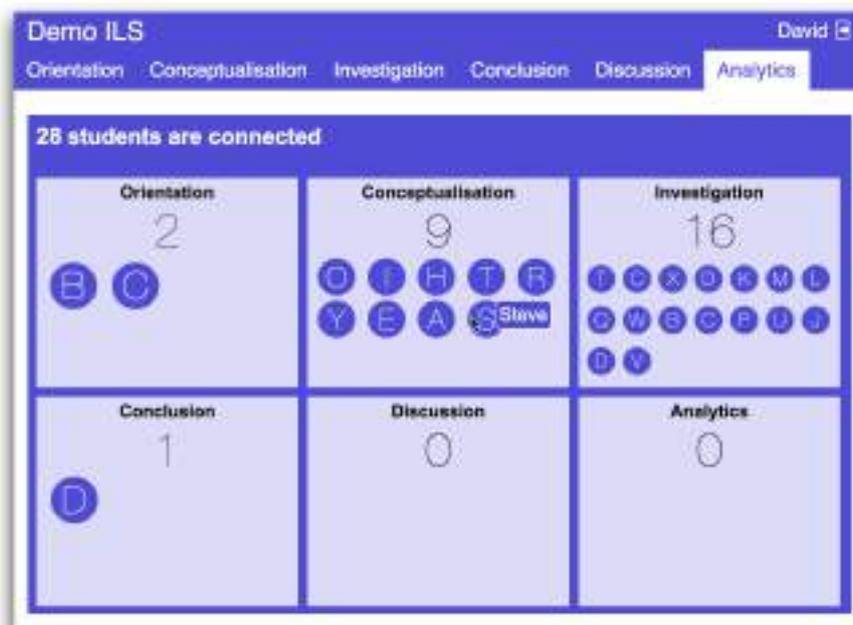
### 2.3.6 ConceptCloud

<b>Keywords</b>	Content Analysis, Artefact Aggregation, Reflection and Monitoring
<b>Main Contact(s)</b>	Sven Manske, University of Duisburg-Essen, manske@collide.info
<b>Summary</b>	The ConceptCloud aggregates the main concepts of different artefacts and artefact types in a single tag-cloud-like representation.
<b>Stakeholder(s)</b>	Teachers & Students.
<b>Architectural Approach</b>	OpenSocial App and LA service.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Artefact Aggregation Service, DBPedia Spotlight Service
<b>LA agents used</b>	-
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	<a href="http://golab.collide.info/client/tools/concept_cloud/gadget.xml">http://golab.collide.info/client/tools/concept_cloud/gadget.xml</a>
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/concept_cloud/">http://golab.collide.info/client/tools/concept_cloud/</a>

**Description** The main idea of the ConceptCloud app is to give an overview over all the concepts that occur in text-based artefacts created by the learners across different phases of an ILS. These concepts are displayed in a tag-cloud-like representation, including comparative operators. Therefore, the ConceptCloud aggregates all concepts of all students, providing a model of the whole class using the ILS. The size of each concept indicates the number of occurrences of each term, while the colours of a concept show if a term is used by students that are different from the one using the ConceptCloud app. Figure 6 shows some concepts in red colour: these concepts are by students different from the viewing student. The student probably effects on this “missing” concept and revisits a phase to add the concept to an artefact. The teacher has additional options to interact with the ConceptCloud. He or she can see all the individual student models but also filter the concepts based on the artefact type of the phases.

The ConceptCloud uses the vault to gather artefacts and an Aggregation Service to extract Concepts depending on the artefact type. In the release version, the following artefact types are supported: Concept Maps, Hypotheses,





**Figure 7.** The *Active Users* app displaying the students active in the ILS phases.

**Description** This app allows the teacher to follow the evolution of the class in the current exercise and spot if some students are not in the phase where they should be, and then act accordingly. Its aim is to give a real-time overview of the number of students in each phase of an ILS. In addition to simply give the number of students, it shows which student is in which phase by representing each of them as a circle that contains the first letter of the students' name. When moving the cursor over the circle, the name of the student appears in its entirety. If the space needed to show the users in one phase is not big enough, the size of the circles representing the users is reduced. However, if the number of users in one phase exceeds 21 people, then new users in the phase are not shown, but the counter indicates the correct number of people in the phase.

Figure 7 shows the *Demo ILS* with the *Active Users* app displaying the students currently active in each phase of the ILS. It is obvious that the majority of the students are in the Investigation and the Conceptualisation phases (16 and 9 respectively), that there are 2 recessing students active in the Orientation phase, and 1 advancing student in the Conclusion phase. The app updates in real time as students switch the phases, so the teacher knows where the students are working right now.

### 2.3.8 Time Spent

<b>Keywords</b>	User Activity, Global Participation, Monitoring
<b>Main Contact(s)</b>	Andrii Vozniuk, EPFL, andrii.vozniuk@epfl.ch
<b>Summary</b>	The Time Spent App allows the teacher to monitor in which part of the inquiry learning process the students are active in real-time
<b>Stakeholder(s)</b>	Teacher
<b>Architectural Approach</b>	OpenSocial App, real-time with Websockets.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	-
<b>LA agents used</b>	-
<b>Golabz URL</b>	<a href="http://www.golabz.eu/apps/student-time-spent">http://www.golabz.eu/apps/student-time-spent</a>
<b>App/Gadget URL</b>	<a href="http://shindig2.epfl.ch/gadget/activity_streams/time_spent/gadget.xml">http://shindig2.epfl.ch/gadget/activity_streams/time_spent/gadget.xml</a>
<b>Demo URL</b>	<a href="http://www.golabz.eu/apps/student-time-spent">http://www.golabz.eu/apps/student-time-spent</a>

**Description** This app allows the teacher to see whether some phases take the students more time than expected, so those phases can be changed. She would also be able to spot if some students take more – or less – time than others to do some tasks and take actions accordingly. The aim of this app is to have a real-time overview of the time spent by each student in each phase of an ILS. If a student is currently in one phase, it will show the timer running for this student in this phase. It also gives the average time spent by students for each phase. If the time spent in one phase exceeds one hour, then the hours digits are shown. In contrast to the Timeline app, this app does not show the transitions between the phases but the accumulated time per phase.

Figure 8 shows the *Demo* ILS with the *Time Spent* app displaying individual and average time spent by students in each ILS phase. When the student is active in one specific phase, the teacher is able to see the timer running for this student in that phase in real time. Additionally, the average time spent by students in each phase is given, so it is possible to compare individual performances of students to the average performance of the group.

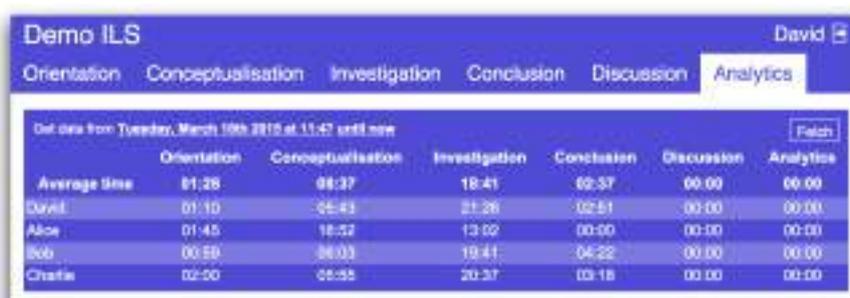


Figure 8. The *Time Spent* displaying the time spent by students in the ILS.

### 2.3.9 Submitted Reports

<b>Keywords</b>	User Activity, Global Participation, Monitoring
<b>Main Contact(s)</b>	Andrii Vozniuk, EPFL, andrii.vozniuk@epfl.ch
<b>Summary</b>	The Submitted Reports App allows the teacher to monitor which students have submitted the reports in real-time
<b>Stakeholder(s)</b>	Teacher
<b>Architectural Approach</b>	OpenSocial App, real-time with Websockets.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	-
<b>LA agents used</b>	-
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	<a href="http://shindig2.epfl.ch/gadget/activity_streams/submitted_files/gadget.xml">http://shindig2.epfl.ch/gadget/activity_streams/submitted_files/gadget.xml</a>
<b>Demo URL</b>	-

**Description** This app allows the teacher to see at a glance which students have uploaded an activity they must hand in, but also when they did so. Its aim is to have a real-time overview of the submitted files of each student in the ILS. When a student submits a file, her name appears in the app with the name of the file she submitted below, as well as the relative time when she did so. If she submits a new file, her name is not added again, but the name of the file is just added below the previous files she submitted. When moving the cursor over the file description, the relative time is replaced by the absolute time. The total number of students who submitted files is also given.

Figure 9 shows the *Demo ILS* with the *Submitted Reports* app displaying the files submitted by students in the ILS and the time when it was done. It is updated in real time as well. Therefore, every time a new report file is uploaded in any phase of the ILS, a new line appears in the interface.

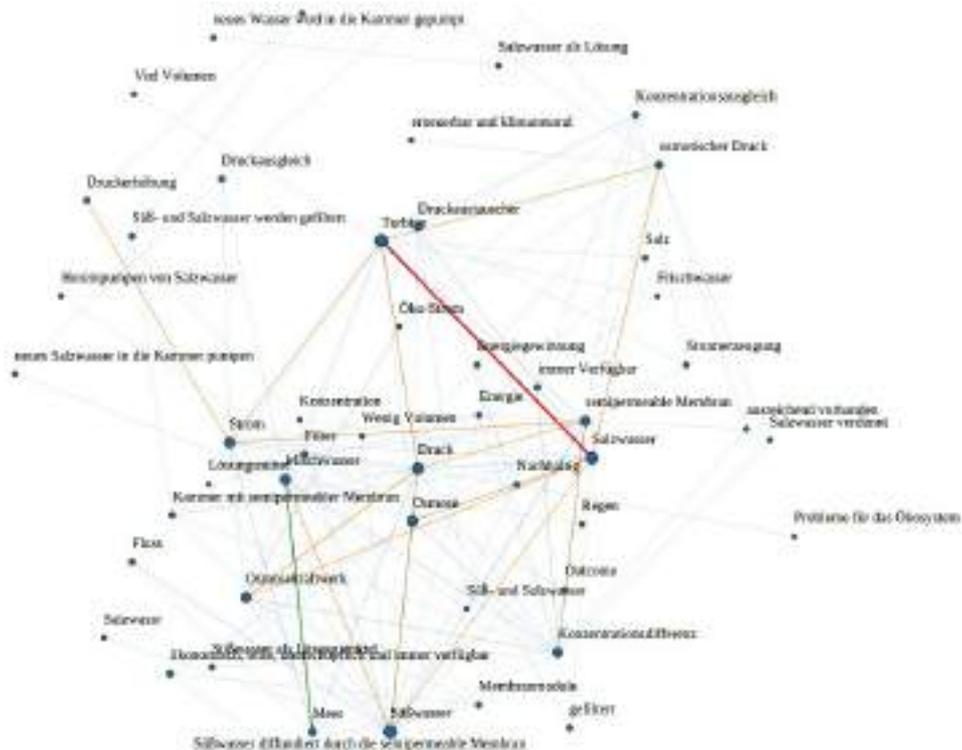


Figure 9. The *Submitted Reports* app displaying the submitted reports.

### 2.3.10 Concept Map Aggregation

<b>Keywords</b>	Content Analysis, Concept Mapping, Artefact Revision
<b>Main Contact(s)</b>	Sven Manske, University of Duisburg-Essen, manske@collide.info
<b>Summary</b>	The Concept Map Aggregation app takes all concept maps of an ILS and aggregates them to a single graph.
<b>Stakeholder(s)</b>	Teacher, students.
<b>Architectural Approach</b>	OpenSocial App and LA service.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Concept Map Aggregation Service
<b>LA agents used</b>	-
<b>Golabz URL</b>	<a href="http://www.golabz.eu/apps/concept-map-aggregation">http://www.golabz.eu/apps/concept-map-aggregation</a>
<b>App/Gadget URL</b>	<a href="http://golab.collide.info/client/tools/concept-map-aggregation/gadget.xml">http://golab.collide.info/client/tools/concept-map-aggregation/gadget.xml</a>
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/concept-map-aggregation/">http://golab.collide.info/client/tools/concept-map-aggregation/</a>

**Description** The Concept Map Aggregation app takes all concept maps of students in an ILS and aggregates them to a single graph. On the server side, graph representations of the student concept maps are aggregated as the union of all graphs, where the matching is based on node labels. However, edge labels are omitted to overcome the problem of a higher divergence between different relation labels, e.g., for inverse relations and naming conventions. The number of occurrences of each node and each edge is highlighted in the graphical representation of the aggregated graph. Figure 10 shows an aggregated concept map of a whole class from an implementation activity of the second pilot phase.

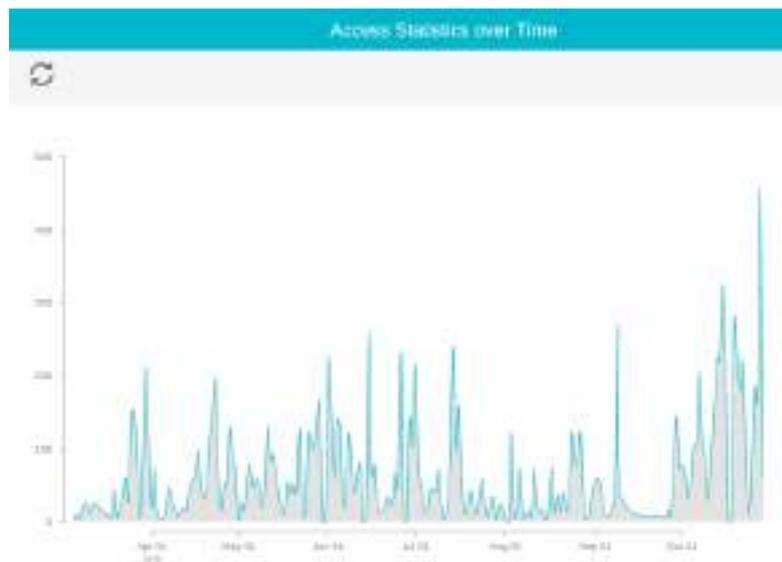


**Figure 10. An aggregated concept map of a whole ILS from a (German) implementation activity.**

This has been used in the activity to negotiate about a useful parameter model for a simulation and to initialize group learning processes (Manske, Hecking, Chounta, Werneburg, & Hoppe, 2015).

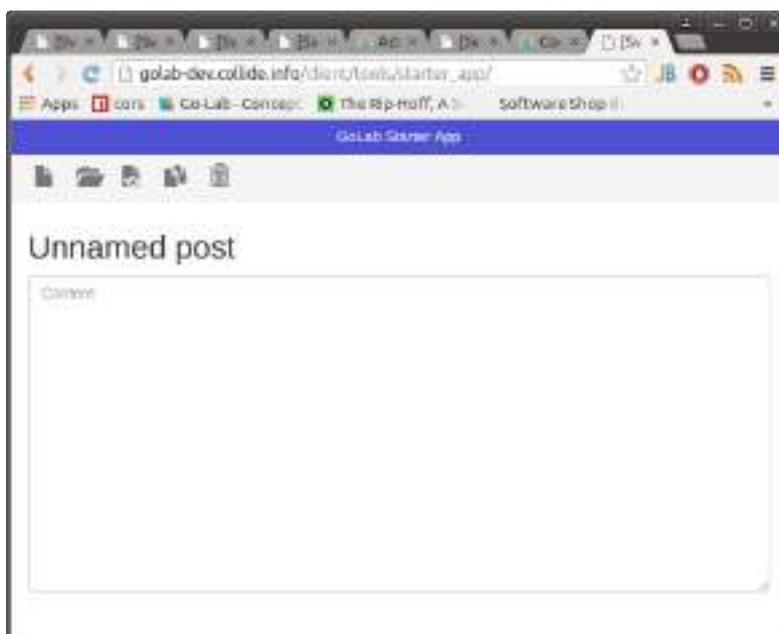
### 2.3.11 Lab and App Statistics in Golabz

<b>Keywords</b>	Resource Access, Lab Usage
<b>Main Contact(s)</b>	Sven Manske, University of Duisburg-Essen, manske@collide.info
<b>Summary</b>	The Golabz Statistics app indicates lab usage over time.
<b>Stakeholder(s)</b>	Lab-Owners and App-Owners
<b>Architectural Approach</b>	OpenSocial App and LA service.
<b>Mode of execution</b>	On-Demand.
<b>LA services used</b>	Action Log Aggregation Service
<b>LA agents used</b>	-
<b>Golabz URL</b>	-
<b>App/Gadget URL</b>	-
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/golabz_stats/">http://golab.collide.info/client/tools/golabz_stats/</a>



**Figure 11. The usage statistics of the Hypothesis Scratchpad.**

**Description** The Lab and App Statistics app targets lab owners and app creators and displays the number of resource accesses, indicating the usage of their lab. In contrast to other learning analytics apps, the target platform for this app is Golabz (cf. D5.6) and not Graasp. Therefore, the visual styles are adapted to the style guidelines of Golabz. It will not be generally available but automatically displayed when a lab or app owner is logged in to Golabz. Figure 11 shows the app usage of the Hypothesis Scratchpad over time. The lab/app usage is measured from action logs indicating that the ILS activity involved the tool for a user, typically based on “application\_started” action logs, which are sent out once per ILS and student.



**Figure 12. The demo view of the starter app. This can be used to test action logging, storage handling or notifications.**

### 2.3.12 Starter App

<b>Keywords</b>	Development Skeleton and Demo-App
<b>Main Contact(s)</b>	Daniel Rose and Sven Manske, University of Duisburg-Essen, rose@collide.info, manske@collide.info
<b>Summary</b>	The Starter App is a skeleton and demo-app for using learning analytics services and Go-Lab integration libraries, such as action logging, (vault) storage, etc.
<b>Stakeholder(s)</b>	Go-Lab Consortium/Developers
<b>Architectural Approach</b>	OpenSocial App.
<b>Mode of execution</b>	-
<b>LA services used</b>	-
<b>LA agents used</b>	-
<b>Golabz URL</b>	-
<b>Source Code</b>	<a href="http://projects.collide.info/svn/golab/trunk/client/tools/starter_app/">http://projects.collide.info/svn/golab/trunk/client/tools/starter_app/</a>
<b>Demo URL</b>	<a href="http://golab.collide.info/client/tools/starter_app/">http://golab.collide.info/client/tools/starter_app/</a>

**Description** This is an example or template app serving as a starting point to build apps for Go-Lab, as well as a reference for interaction with Go-Lab integration libraries. It demonstrates Go-Lab functionality such as

- persisting and reading resources from an artefact storage,
- sending action logs,
- handling different app contexts, such as distinguishing teacher and student view,
- receiving notifications,
- introspecting the ILS phases,
- translating messages (configurable with the AppComposer: <http://composer.golabz.eu>,
- configuring the app (either in the app itself or using the AppComposer).

Additionally, some components relevant to most (Go-Lab) applications are set up: a toolbar, a user facing error display, and a loading indicator. This template app bundles best practices for Go-Lab learning analytics app development in a practical example that can be adapted easily. The development of new learning analytics apps has been described in deliverable D4.6 and the developer documentation, available online at <http://golab-dev.collide.info>.

## **2.4 Implementation of Teacher Dashboards in Go-Lab**

The apps presented in the previous section can be arranged on a single screen to provide all information needed by the teacher at once (Few, 2007). Furthermore, the teacher is able to adapt the dashboard to her personal needs by adding or removing individual apps from the Dashboard space (see Figure 13). Such a dashboard, once built for an ILS, can be ported and reused in another ILS (Vozniuk et al., 2013) just by copying the dashboard space. Through the Space extension<sup>1</sup> of OpenSocial that is implemented in Graasp, LA apps can be made context-aware (i.e. knowing the ILS structure, with the corresponding roles and privacy settings, that can be enforced, and thus enable control over the selected LA data in the dashboard).

Although teachers may create their own dashboards, the ILS platform now supports the creation of ILSs based on the chosen template. These templates support the implementation of pedagogical scenarios and the creation of ILSs with different configurations of dashboards ready to be used (see Figure 14). For example, those dashboards may focus on awareness for teachers (with feedback about the ongoing learning activity), or reflection for either teachers or students on the learning process. When pressing “create ILS”, users can select the appropriate template from a drop down list and a new ILS will be generated. The drop down menu is utilised by any ILS created in a special space (illustrated in see Figure 14 and see Figure 15). When a user selects a scenario the system simply makes a copy of the ILS. This scheme makes it easy for WP1 members to generate new templates and modify existing ones. Afterwards, the user can customise the list of apps provided according to the needs of the specific learning scenario.

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<sup>1</sup><http://docs.opensocial.org/display/OSD/Space+Proposal>



Figure 13. Screenshots of the Dashboard showing the list of apps added to the dashboard (top) and the "online users" app with the current phase of those users that are online (bottom)



Figure 14. Templates available.



Figure 15. Screenshot of the ILS creation menu.

## 2.5 Learning Analytics Services and Agents

The overall Go-Lab system has multiple interfaces for different users and stakeholders. In this context, the web portal Golabz serves as an entry point for stakeholders other than learners (especially teachers, but also lab owners). Analytics on this level has been performed using generally available tools for web analytics (such as Piwik and Google Analytics). The results of these analyses have been used as quality and success indicators particularly in WP 6.

The focus of the Go-Lab analytics tools described here is on analysing interactions of learners with ILS. Also in this context, there is a more general approach on the level of Graasp using the OpenSocial API and its log data as they are. More specific applications based on the Go-Lab Learning Analytics backend make use of an adapted format that captures the genuine nature of Go-Lab ILS in terms of the underlying action and entity structures.

An example for a Graasp based analytics app is "Active Users" (see 2.3.7), i.e. students currently connected to a space. The "Reflection Tool - Transitions" (2.3.2) is based on the specific backend and represents the underlying phase substructure and sequencing of ILS. The "Lab and App Statistics" app (2.3.11) is also based on the specific backend and aggregates lab or app usage in a collection of ILS. It is the only example of a specific Learning Analytics app whose results are made available to external stakeholders (other than teachers or learners) through Golabz - in contrast to other apps running mainly in Graasp.

The Go-Lab Learning Analytics Server offers services and agents that are transparent, i.e. invisible to the end user, namely students, teachers, and lab-owners. However, several services and APIs are offered to developers of new learning analytics apps. These are described in the developer documentation that can be found online at <http://golab-dev.collide.info>. It also includes the documentation for the development of apps, as described with example cases in

deliverable D4.6. For the flexibility of the architecture and to ease up development in a distributed project, different approaches are offered through the infrastructure and are available to the developers of apps. The documentation is organised into the following aspects:

- Overview Information,
- Frontend Development - Apps,
- Backend Development - Agents,
- Backend Development - Services.

### 2.5.1 Overview Information

Currently, the most recent deliverables that give an overview over the development of learning analytics tools for Go-Lab are D4.2, D4.4 and D4.6. Information from this deliverable relevant for the development is listed there.

### 2.5.2 Frontend Development (Apps)

The frontend of a typical learning analytics tool is the App that can be integrated into an ILS in Graasp. There are currently two main information sources for the development of such an app:

First, the documentation of the ILS library for Go-Lab on GitHub. This includes an API documentation and HowTos for most aspects. Second, the source of the Starter App, which is intended to be a well documented starting point for app development and which contains code examples for many common tasks of an app.

### 2.5.3 Backend Development

The development of learning analytics apps might involve the gathering and the processing of data. Data might be retrieved through backend services. In this section, we describe different approaches supported by the Go-Lab backend services that enable retrieval or processing of data.

**Activity streams** A primary data source for learning analytics is process-oriented data, particularly action logs. The stream of action logs is called an activity stream, the JSON format of these logs is called ActivityStreams. The concept and the format have been described in detail in the former deliverables D4.4 and D4.6. Apps can directly connect to the activity stream of a space the app is running in through the OpenSocial API, which is provided directly through Graasp. The simplest form of learning analytics apps might only use "local" processing of this stream. In contrast to this, apps that use more specific analytics features will use agents or services of the Learning Analytics Backend for retrieval and processing.

**Agents** Agents in the Go-Lab LA Backend are mainly intended for processing real-time information and providing notifications based on that. Documentation

for agent development falls into the following categories:

- receiving input (action information) and sending output (notifications) via SQLSpaces,
- general information on the SQLSpaces,
- the SQLSpaces API documentation,
- documentation about the tuple formats used in Go-Lab,
- action logs format,
- additional Go-Lab specifications, taken from D4.2, D4.4 and D4.6,
- an example action log,
- notifications format,
- format used for notifications as described in D4.2 and D4.4,
- an example notification.

**Services** Services in the Go-Lab LA Backend are mainly intended for processing on-demand analyses. The Data Warehouse API documentation describes the API for accessing collected action log information in the LA Backend. It contains indicators that might be useful for researchers of the Go-Lab consortium, for example, distance measurements to quantify deviations of concrete (visited) phase sequences of learners compared to the recommended (ILS) model. An example usage of these indicators can be found in (Manske, Chounta, et al., 2015), which describes an analysis of Go-Lab ILSs, particularly of active ones based on indicators and log aggregations on behalf of the Data Warehouse API.

## ***2.6 Golabz Recommender System***

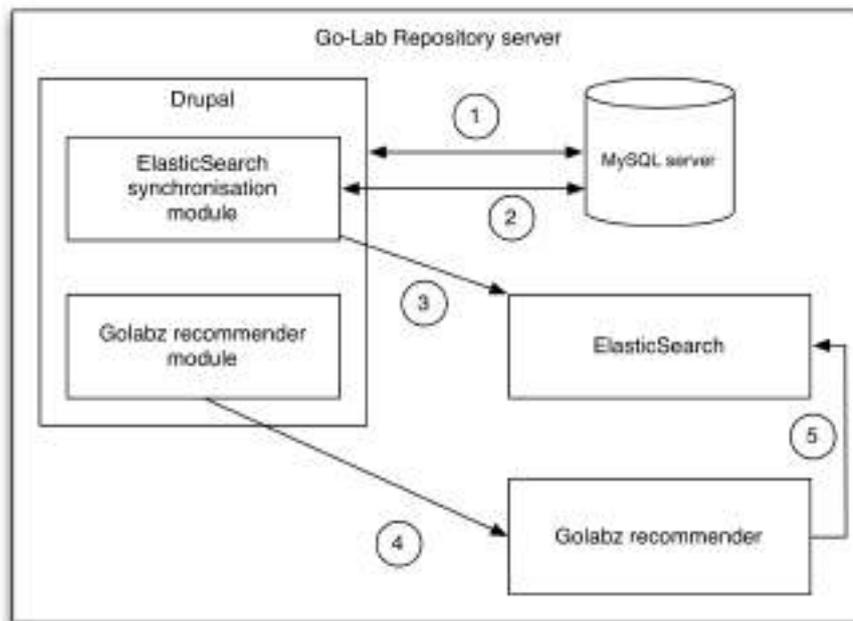
The recommender system is implemented following the specification in D4.6. In short, labs and apps are recommended based on their metadata: title, description, keywords, and page views. Apps also consider the metadata app category. Labs are divided into the metadata grade level, language, big idea of science, subject domain, and lab owner (cf. Section 2.9.2 in D4.6).

Currently, the recommender system has been deployed on the Go-Lab Repository (Golabz), which is realised using the content management system Drupal, as described in D5.2, and uses a MySQL server to store its data (see 1 in Figure 16). We use ElasticSearch<sup>2</sup>, an open-source search engine, as an enhancement of the Drupal search functionality. To use ElasticSearch is a decision considering the future development of Golabz with a large amount of data. In line with the paradigm of cloud computing, ElasticSearch is scalable and can run distributed systems over many clusters for large data processing. Hence, it ensures the real-time execution of the recommendations of labs, apps, and ILS.

The implementation is based on the architecture specified in D4.6, as depicted

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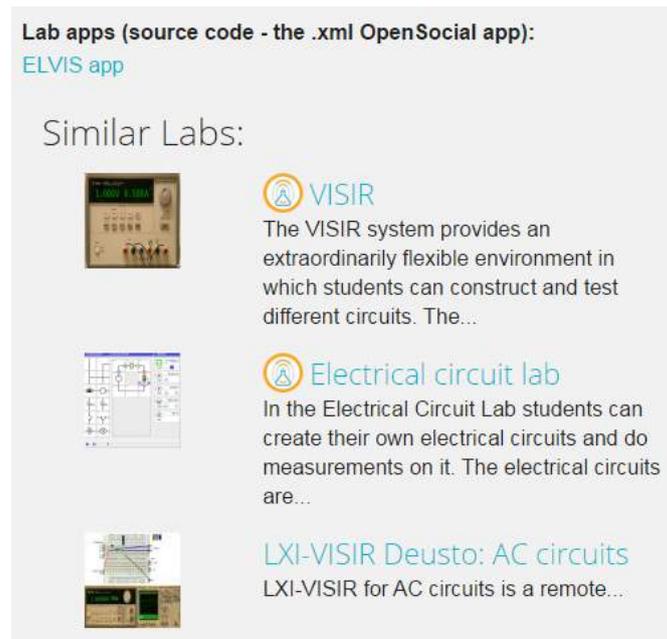
<sup>2</sup>ElasticSearch, <http://www.elastic.co>



**Figure 16. Architecture of the Go-Labz recommender system.**

in Figure 16. In Drupal we have created two modules on Golabz. One is the backend synchronisation module to exchange resources as well as metadata between Golabz MySQL database and the ElasticSearch engine (Arrow 1-3 in Fig. 16). The other is the recommender module which calls the recommender service (Arrow 4) to render the recommendation results on the frontend. For example, Figure 17 shows how users get recommended labs similar to the remote electricity lab ELVIS/OP-AMP labs<sup>3</sup>. Ajax is used to load the recommender results so that the loading time of the Golabz lab and app page is not influenced by the recommendation time.

<sup>3</sup> <http://www.golabz.eu/lab/elvisop-%E2%80%93-amp-labs>



**Figure 17. The screenshots of similar labs listed on a lab page.**

The recommender itself is implemented as a separate service so that it can also be further used in the ILS platform in the future. It calculates the similarity between labs/apps considering the metadata values and delivers a list of results sorted by the similarity score for Golabz. We list the best three results on Golabz lab or app page. We will improve the recommender based on users' feedback and report in D5.7.

### **3 Add-on services**

#### **3.1 Introduction to Go-Lab add-on services**

Besides the learning analytics as Go-Lab infrastructure services, two add-on services are released to give lab owner added-value services via the Booking System and to support Go-Lab teachers community through the Tutoring Platform.

The Booking System offers the booking services explicitly to remote labs which often have limited resources. The final specifications in D4.6 has been defined based on feedback from (remote) lab owners. In this deliverable, we focus on how the requirements were implemented and the integration with the Smart Gateway / Smart Devices. In the initial release (D4.4), only a demo booking system was launched. In this final release, we have deployed the add-on services to the end users, i.e. lab owners and teachers. This final release is tested systematically. User evaluation is planned after M36, which will be reported as a part of the Go-Lab Portal sustainability development (Deliverable D5.7 in plan) later.

The final release of the Go-Lab Tutoring Platform is accessible at <http://tutoring.golabz.eu/>. It also hosts a community forum <http://tutoring.golabz.eu/forum> which is directly linked from the Go-Lab Portal. The main new features since the initial release contain:

- New design of the tutoring platform since the initial release;
- Broadcasting and Recording the tutoring sessions as Webinars;
- Group email feature for tutors;
- Send users' offer request to tutors;
- A forum for tutors and users as a discussion tool for community building;
- Notification with emails;
- Booking consider different time zones;
- The credit system with Go-Lab badges;
- Improved workflow and usability.

In this deliverable, only the changes to the initial release will be described for the technical implementation. We will not repeat the features which have been developed before but also focus on the first use results after the deployment of the initial release. Considering the reviewers' feedback from the end of the second project year, the tutoring platform has been specified and adapted to become a community building platform for the Go-Lab Portal (cf. D4.6). As of September 15, 2015, 156 users have registered on the tutoring platform.

#### **3.2 Go-Lab Booking System**

Based on the final specification in D4.6, the final release of the Go-Lab Booking System is structured according to the requirements and their implementation



**Figure 18. The lab calendar for teachers.**

respectively. The special challenges for the Smart Gateway for integration is discussed at the end of this section.

All remote labs which require users' booking in the Go-Lab Repository (Golabz) could use this booking service. Currently there are six such booking-required remote labs hosted in Golabz. As the next step, lab owners of these labs will be contacted and asked whether they want to manage their booking with the Go-Lab Booking System. We will report the negotiation results with lab owners in the deliverable D5.7 *Sustainable releases of the Go-Lab Portal and App Composer* by M48.

### **3.2.1 Requirements and releases**

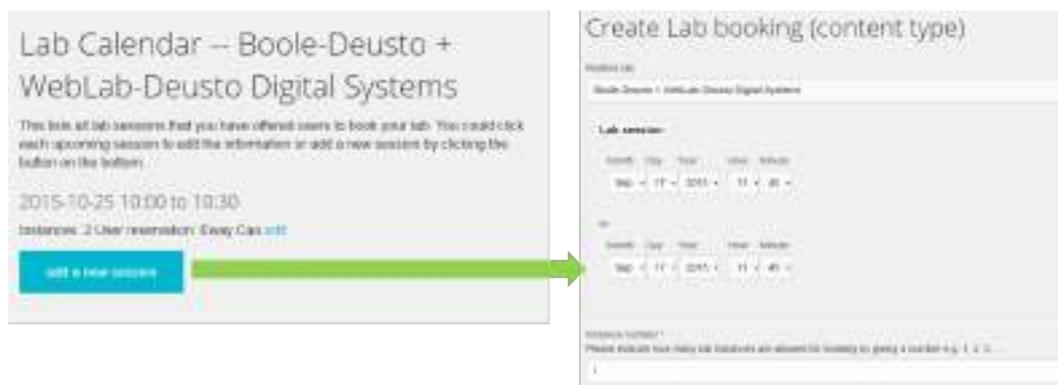
#### **3.2.1.1 Single sign-on.**

User login is in line with the Go-Lab Portal. Go-Lab Inquiry Learning Platform (Graasp) user login and management is also used for the booking system. The user login is necessary for the users to book a lab session.

#### **3.2.1.2 Booking a lab**

If the lab type is remote lab and booking is required by this remote lab, a blue button of "Go booking" is listed on the lab page. Lab owners can plan the use of their remote labs in advance. Teachers can access the calendar with lab availability and make a reservation of a certain remote lab. The lab facility and the teacher and its class could be in different time zones. So the booking system supports different time zones.

Figure 18 shows the user interface of the lab calendars. A teacher could book a lab session using the lab calendar by clicking the green spot.



**Figure 19. The lab calendar user interface for lab owners.**

### **3.2.1.3 Administer lab calendar**

Lab owners can add and edit time slots in the lab calendar to show when their labs will be available to Go-Lab users. Lab owners can indicate how many physical instances they provide access to. A Go-Lab lab owner could create a lab use sessions for his/her remote lab and manage the calendar.

Figure 19 shows the user interface for lab owners to manage their lab calendars by adding and editing the calendar. Each remote lab has one lab calendar.

All sessions with the booking information such as users who have made the booking are listed too. The lab owner can have the overview of all bookings about his/her remote lab.

### **3.2.1.4 Booking for multiple instances**

Teachers can book as many as lab sessions, if a multiple physical instances of this remote lab are available and the number of the booked lab sessions is smaller than the number of the physical instances.

Figure 20 shows the teacher can further book another session, so far she has booked only one and the physical instances are two for this lab.

### **3.2.1.5 Running a booked lab in an ILS**

The Smart Gateway provides a unified interface to enable external laboratories to be integrated in Go-Lab. It supports a set of plug-ins for different laboratory management systems. Each plug-in may support one or more laboratories. The user access grant mechanism used in the Smart Gateway is based on token provision and reservation. When a remote lab instance is called, the Smart Gateway validates the users and their booking information through the Go-Lab Booking System. If the information is valid, the Smart Gateway grant the users' access to the certain remote lab.

The final laboratory is responsible of implementing a fine-grained scheduling system for these users. For example, the Go-Lab Booking system will only allow students from a certain ILS to go to a particular laboratory during a period of time. However, this laboratory must be able to manage the concurrency of these

**Related lab:** Boole-Deusto + WebLab-Deusto Digital Systems  
**Lab session:** Sunday, October 25, 2015 - 10:00 to 10:30  
**Instance number:** 2  
**User reservation:** Eway Cao  
**Your ILS student link \*:**  
 Please give the URL (student link) of your ILS in which this lab will be used after booking (mandatory).

e.g. <http://graasp.eu/ils/54c79d1c479265d7425bf50c>

Booking

Cancel this booking

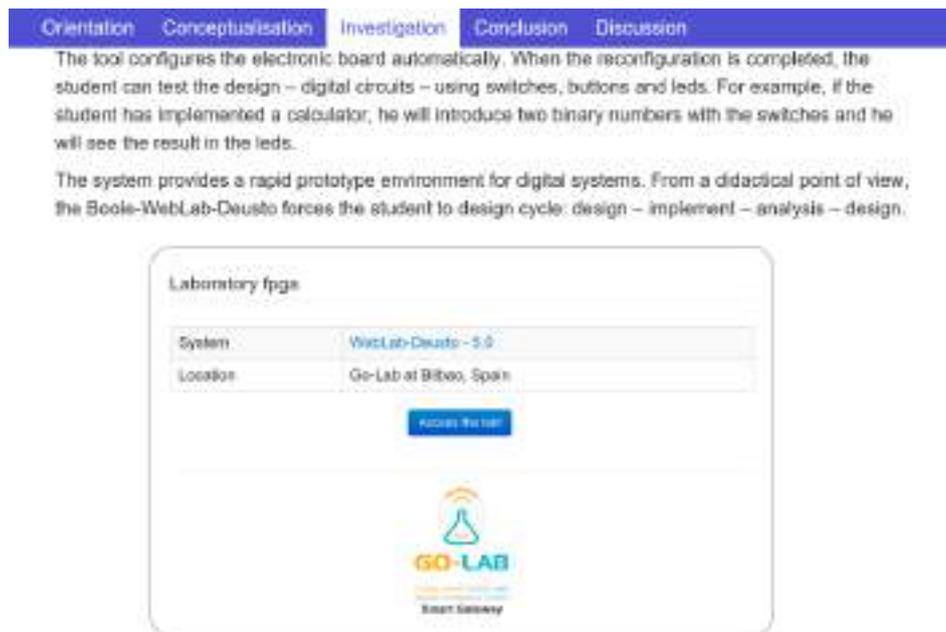
**Figure 20. The lab calendar user interface for lab owners.**

users (e.g., implementing a queue of users). It is still an important advantage for the lab owners, since this mechanism limits the number of concurrent users they will receive, and therefore, there would never be long queues.

The booking system offer the Restful service to send the Smart Gateway the booking information of certain labs in the future.

```
[{
  "title": "Boole-Deusto + WebLab-Deusto Digital Systems",
  "id": "2733",
  "ils_url": "http://graasp.eu/ils/55f99c35b8fd4d2280c73f91",
  "user_id": "1228",
  "user_mail": "useremail@mail.com",
  "start_time": "2015-10-25T09:00:00",
  "end_time": "2015-10-25T09:30:00",
  "lab_apps": [
    {
      "app_url": "http://gateway.golabz.eu/os/pub/fpga/w_default.xml",
      "app_type": "Open Social widget"
    }
  ]
}]
```

Information about a lab and its widget url, ILS url (the url for the student view), as well as the time slot is included in the JSON message between the booking system and the Smart Gateway and Smart Devices.



**Figure 21. Using the lab inside a booked session.**

Additionally, we consider the scenario that the booking system should not block a Go-Lab remote lab if no users have booked it. A null message will be returned if no reservation has been made, and therefore the Smart Gateway will enable any user to access the lab at that time without booking.

When accessing the lab in a booked ILS, or during a time where nobody has booked a session, it shows an "Access the lab!" message, as depicted in Figure 21. However, if used when somebody else has booked a session, an error message will be shown, as depicted in Figure 22.

### **3.2.1.6 Cancelling booking**

After a teacher booked a lab session, he/she can cancel his/her own previous session. As teachers may change their minds about one booking, the cancellation assures other teachers' booking then. It is simple to cancel in the booking system just by clicking the cancel button as depicted in Figure 20.

### **3.2.1.7 Closing a booked lab session**

Once the reservation time has expired, no new reservation will be allowed, unless nobody has made booked the laboratory at that time. During a period of time where there is no booking, everybody can use the laboratory.

## **3.2.2 Smart Gateway integration: selecting which labs use the booking mechanism**

In the case of the Smart Device, the Smart Device itself must implement the support for the booking mechanism.

In the case of the Smart Gateway, the booking system is implemented as a common module. As detailed in D4.7 (Releases of the Lab Owner and Cloud



**Figure 22. Using the lab without booking during a booked session.**

Services (Final)), the Smart Gateway consists of a central software component which supports a plug-in mechanism to support external laboratories. The laboratory owners must implement a plug-in or support an HTTP interface (section 3.4.3 of D4.7) to have their laboratories included in the Smart Gateway. However, given that the booking system is implemented as a common module, it does not affect these plug-ins or this HTTP interface, so laboratory owners do not need to make changes in their software.

When registering laboratories in the Smart Gateway, the Smart Gateway administrator must select which laboratories need this mechanism as depicted in Figure 23. The booking service focuses on providing an added value for teachers: in an scenario with no booking, everyone can use the laboratory, and the laboratory is expected to manage the concurrency (e.g., using a queue). But if a laboratory is used by many people, the mechanisms could be not effective (e.g., too many people in the queue), which may deal to unsatisfactory situations (e.g., the teacher not being able to use the laboratory in class due to the size of the queue). For this reason, Go-Lab can require booking to its users to access those labs which are used very often, without laboratory owners noticing. To explain this approach, a proper comparison would be the seats in a train. In some trains, seats are not numbered, and people can seat wherever there is a seat. But in some other situations (especially those on which the train is expected to become crowded), the seats are numbered, and only in those situations people have to seat in those seats. This is the same for the booking service: if nobody has booked a session, anyone can use it. But if a teacher wants to guarantee that only their students can access so as to guarantee that the queue is short, and only during those slots no other teacher will be able to access. The other



**Figure 23. All the labs in the Smart Gateway provide an option of "Activate" / "Deactivate" the booking mechanism.**

circumstance under which supporting booking in a laboratory would be interesting is for those laboratories where the laboratory owners have explicitly stated that they do not want to have too many students at the same time, and this mechanism enable Go-Lab to state that if the mechanism is enabled, there will never been more users than those from a particular ILS at the same time.

Once activated, the Smart Gateway will check whether the current user is in an ILS that the Go-Lab Booking service reports that it has exclusive access to the lab. By default, in the Smart Gateway no laboratory uses the booking service until explicitly activated. If there is no booked session, the final result is the same as if it was deactivated: any user would start using the laboratory. However, in many laboratories (especially simulations), checking booking when it is naturally unnecessary would lead to a less efficient service.

### **3.3 Go-Lab Tutoring Platform**

The final release of the Go-Lab Tutoring Platform is <http://tutoring.golabz.eu>. The final release has been implemented based on the final specification (D4.6). As pointed out in D4.6, reviewers' feedback and users' feedback to the initial release is well taken into consideration. Feedback from research papers have been considered as well (Govaerts et al., 2015; Cao et al., 2014) How we deal with the reviewers' feedback can be found in D4.6 and will not be repeated here.

The implementation of the requirements is described in the final specification. We focus on the changes since the initial release. Thus, if the implementation has not been changed and only some performance improvement has been conducted compared to the initial release, the requirements will be skipped.

The design of the tutoring platform is new since the initial release. Figure 24 shows the home page which uses the same design scheme of the Go-Lab Portal. The new design aims to keep the tutoring platform and the Go-Lab Portal share the similar look and feel. Employment of the same design scheme is also the consideration of the tutoring platform as a community building platform for the portal.

Besides the requirements implementation, the tutoring platform has hosted 9 external tutoring sessions. We don't count the sessions which have only been used by the Go-Lab partners. The 9 "external" sessions have been attended by



**Figure 24. The homepage of the Go-Lab Tutoring Platform.**

the Go-Lab teacher community who are also attending the Go-Lab Contest, the summer schools and workshops etc. The 9 sessions took place from February to July 2015. According to the topics, we could group them in two topics. The first 5 sessions pertained to supporting users to use the Go-Lab Portal. About 25 users have attended in this topic in total. The participation and users' feedback are described below in this section too (Cao et al., 2015). And the last 4 sessions pertained to interviews to teachers organized by the Go-Lab consortium partner EUN. EUN has conducted face-to-face interviews with teachers since the beginning of the project. The tutoring platform gives them the possibility to conduct interviews online "face-to-face" using web cameras. Over 10 teachers have attended the interviews on the tutoring platform in total. Work Package 8 report these interview sessions in D8.4

### 3.3.1 Requirements and releases

#### 3.3.1.1 Sign-on

As mentioned in the initial release, Google Hangouts service is used. To response reviewers' feedback, the tutoring platform Users are supported to log in with their Google account in the final release. Meanwhile, the prerequisite of having a Google account is not necessary for login any more. Users are able to register to the Go-Lab Tutoring platform with any email address, after they confirmed the existence of their email account. Although Hangouts service is still in use. Teachers are encouraged to also use the tutoring platform to give

comments and join in the forum, besides taking a help sessions with the video.

### 3.3.1.2 Managing a tutor/user profile

Since the initial release new features include reset/change passwords, set time zone of users' own account, and select labs in which the tutor is the expert. Users are enabled to manage their user profile (description, reviews, lab specialist information) and user account (email address, password management) separately. Figure 25 shows the user profile display.

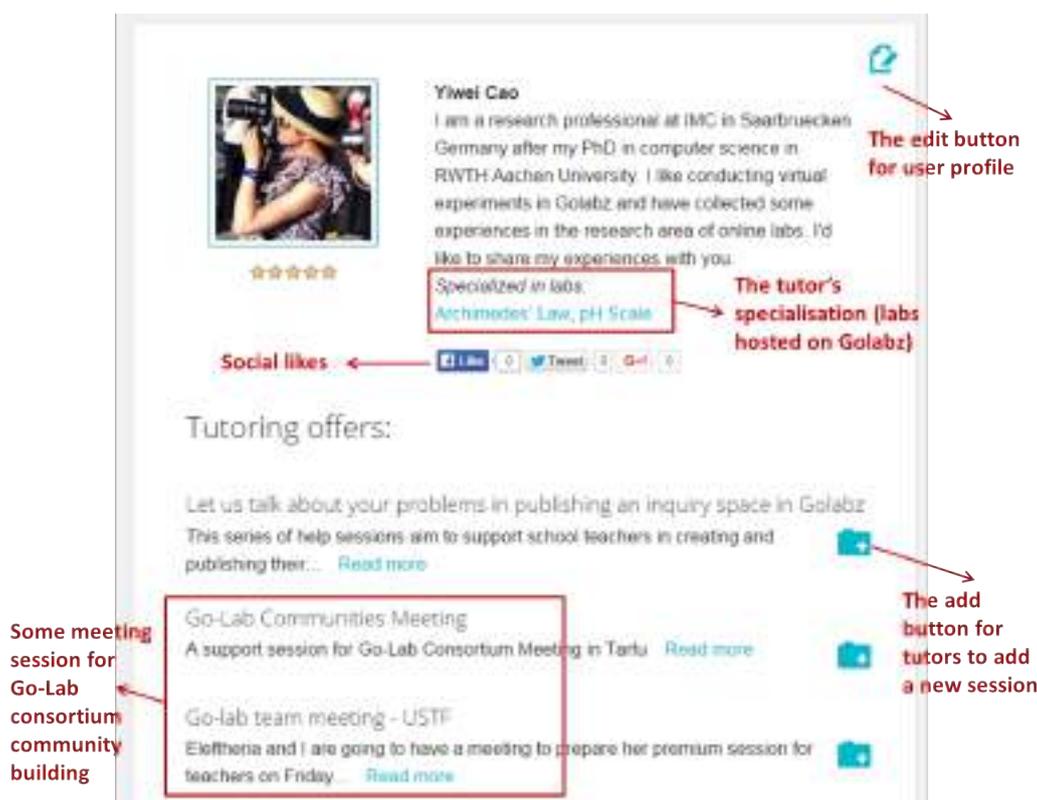


Figure 25. The screenshots of tutors' profile.

### 3.3.1.3 Contacting, bartering, and communicating at tutor time

Communication channels (e.g. email and video or audio chat tools) are required for contact information and bartering process between tutors and Go-Lab users. Above all, this communication channel enables tutors to assist Go-Lab users. A video chatting channel is provided to create a real-time, face-to-face like help from tutors to Go-Lab users. Tutors also require a resource upload tool to share learning resources with the users who need tutoring, such as video resources. Screen sharing and documents sharing can further facilitate the help session.

According to the feedback from teachers conducted by Work Package 2, teachers should be able to send a request easily to the tutors if they need a help session, while the tutor does not offer the session in his/her offer at that moment. The users are able to click the flag symbol on the tutors' offer pages (cf. Figure 28). The tutor can see how many requests he/she has received.

**Figure 26. Tutors can create a session and specify if it is a Webinar.**

The tutor can also reset the request number to zero if he/she is going to offer a session.

#### **3.3.1.4 Broadcasting and Recording the tutoring sessions**

This is a new requirement based on the first-hand use experiences within the Go-Lab community cluster with teachers. A broadcasting session makes it possible to support as many teachers as possible. Recording enables the teachers to repeat the learning content afterwards.

Figure 26 demonstrates that a tutor is able to specify if the session should be recorded.

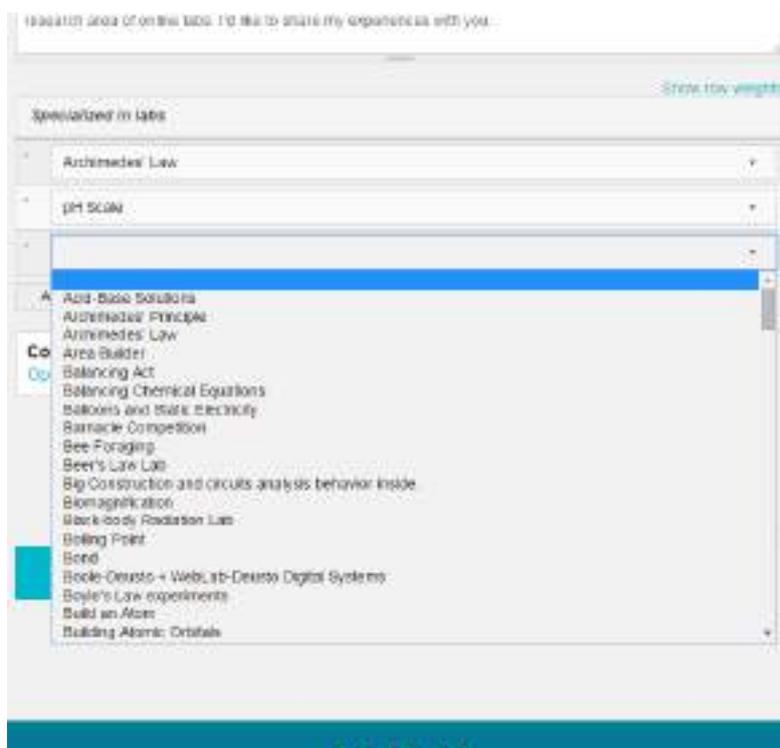
All previous recorded tutoring sessions can be accessed from the Webinars block on the home page (cf. Figure 24). As of September, 2015, six webinars have taken place.

#### **3.3.1.5 Recommending tutors**

This is combined with social sharing. The community cluster requires this feature for community support by the Go-Lab ILS experts. Thus on the page of each tutor, social like buttons from Facebook, Twitter, Google Plus are implemented (cf. Figure 25). In addition, users are encouraged to give feedback to a tutor by leaving a review message and rating with 1-5 stars on the tutor's profile page. The average rating is displayed beneath the tutor's profile photo. And the tutor list on the home page is also listed according to this rating.

#### **3.3.1.6 Searching tutors and listing tutors**

Tutors could be searched on the search box in the header. Users could find the upcoming tutor help session just by click the link of "Go-Lab tutors (with help offers)". Tutors could give the information about which labs they are the specialists. This helps users find the proper tutor for the online labs in the Go-



**Figure 27. The selection list for online labs are retrieved from Golabz at real-time.**

Lab Portal. Figure 27 showed the Go-Lab online lab lists retrieved from the Go-Lab Repository (Golabz) at real-time.

In the current tutoring platform, many tutors have not registered this information about their specialized lab. Hence, we have not forwarded this data further to the portal via Web services. In future, a list of experienced tutors will be provided per lab in the Go-Lab Repository. This could also be applied to ILS and apps.

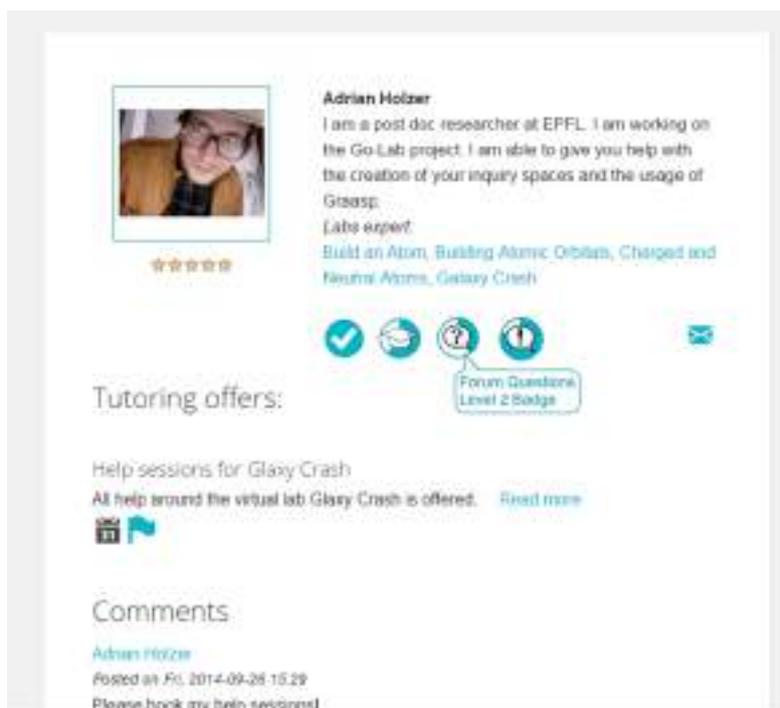
### **3.3.1.7 Assigning credits to users**

In order to motivate the teachers and support the community, the badges will be assigned to users. This also contributes to the sustainability of the platform. Due to the lack of user activity in the current release, we have not integrated the badge into the system. The user interface is designed as depicted in Figure 28.

As the first step, we could assign the badges to users according to the following categories:

- Go-lab approved tutors;
- the number of the sessions the tutor offers;
- the number of the offers the tutor provides;
- the number of the questions the user posts in the forum;
- the number of the answers the user replied in the forum.

Furthermore, the badges could be assigned based on the quality of the ques-



**Figure 28.** The mock-up of listing badges on a user's profile page.

tions and answers in the forum, which could be measured by “like” and “dislike” rates given by other users. The badge assignment rules could also be related to users' activities in the portal. Aiming at the portal sustainability, this feature is an approach to motivating users to join and to be active in the tutoring platform. More collaboration will be carried out together with Work Package 6, the community building.

### **3.3.1.8 Notify Go-Lab users and tutors**

Notifications are sent out of the tutoring platform in several cases. Tutors are notified if their sessions are booked or booking cancelled by users. Tutors are able to send a group emails to all users who have booked the session to keep them posted with information, as depicted in Figure 29. Users get a reminder email shortly before the session. Similar to the booking system, the time zones are taken into account.

### **3.3.1.9 A forum for tutors and users**

This is a new requirement aiming at community building. A forum should be established to enable users and tutors to communicate and exchange expertise among themselves, besides email contacting and video chatting. Figure 30 shows a discussion thread of a forum topic. After a forum topic is posted, the logged-in users could post their replies to the topic, or to the individual replies. User could also like or dislike the replies.

There is a special search function dedicated to the forum. If a user has a certain question, he/she should search the forum first to find the answers, before he/she posts the question.

My Tutoring Sessions:

Topic	Session Title	With Whom	Session Time	Session Link	Receive a tutorial?
Topic List	Can you help with problems in solving an equation in context?	Yanqi Liu Yanqi F. Peng Cecilia Maria Pedersen Erik J. (Erik) Jensen Johanna Liz Holmberg Lorenz Lorenz Svenja Thiele	Mon, 2015 04-20 13:30	Helped	<input type="checkbox"/> Yes, please <input type="checkbox"/> No, thanks
Topic List	Can you help with...?	Yanqi Yanqi F. Peng Erik J. (Erik) Jensen Johanna Liz Holmberg	Wed, 2015 05-20 13:30	Helped	
Topic List	Can you help with...?	Go-Lab Tutor	Thu, 2015 05-17 13:30	Helped	
Topic List	How to use...?	Go-Lab Tutor	Wed, 2015 05-20 13:30	Helped	
Topic List	How to use...?	Go-Lab Tutor	Wed, 2015 05-20 13:30	Helped	
Feedback	Helping with the use of the...?	Yanqi Liu Yanqi F. Peng Svenja Thiele Lorenz Lorenz Erik J. (Erik) Jensen Johanna Liz Holmberg Lorenz Lorenz Svenja Thiele	Fri, 2015-05-15 13:30	Helped	

Only the tutor can click the button to email all participants.

Figure 29. The help session list.

GO-LAB Tutoring

Do you know how to use the Go-Lab Portal?

Monday, 22/05 Tue, 2015-05-19 12:06

Would you like to share your experiences of using the Go-Lab Portal here? Looking forward to your posting

Posted by [Yanqi F. Peng](#) Tue, 2015-05-19 21:58

I'm a newbie, but I learn early. :)

Many thanks for your offer to help me.

Your answer:

Use rich text

Post

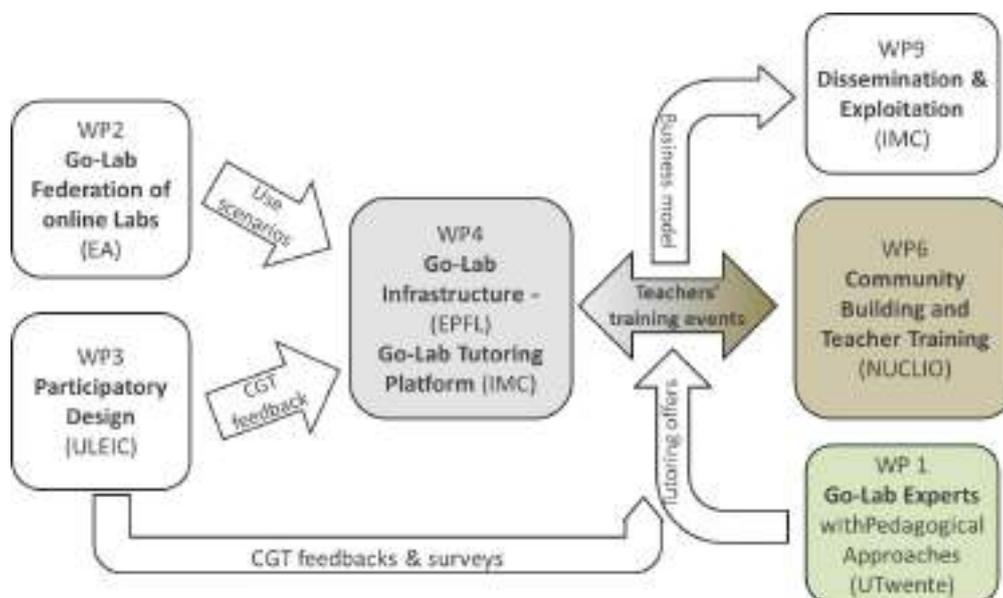
Who's on line

- Yanqi Liu

Who's new

- Svenja Thiele
- Yanqi F. Peng
- Matthew H.

Figure 30. A forum topic discussion in the forum.



**Figure 31. A road map of Go-Lab community building with the Go-Lab Tutoring Platform.**

This forum is linked directly in the Go-Lab Portal as a support means at <http://www.golabz.eu/support>. More details can be found in the deliverable D5.6.

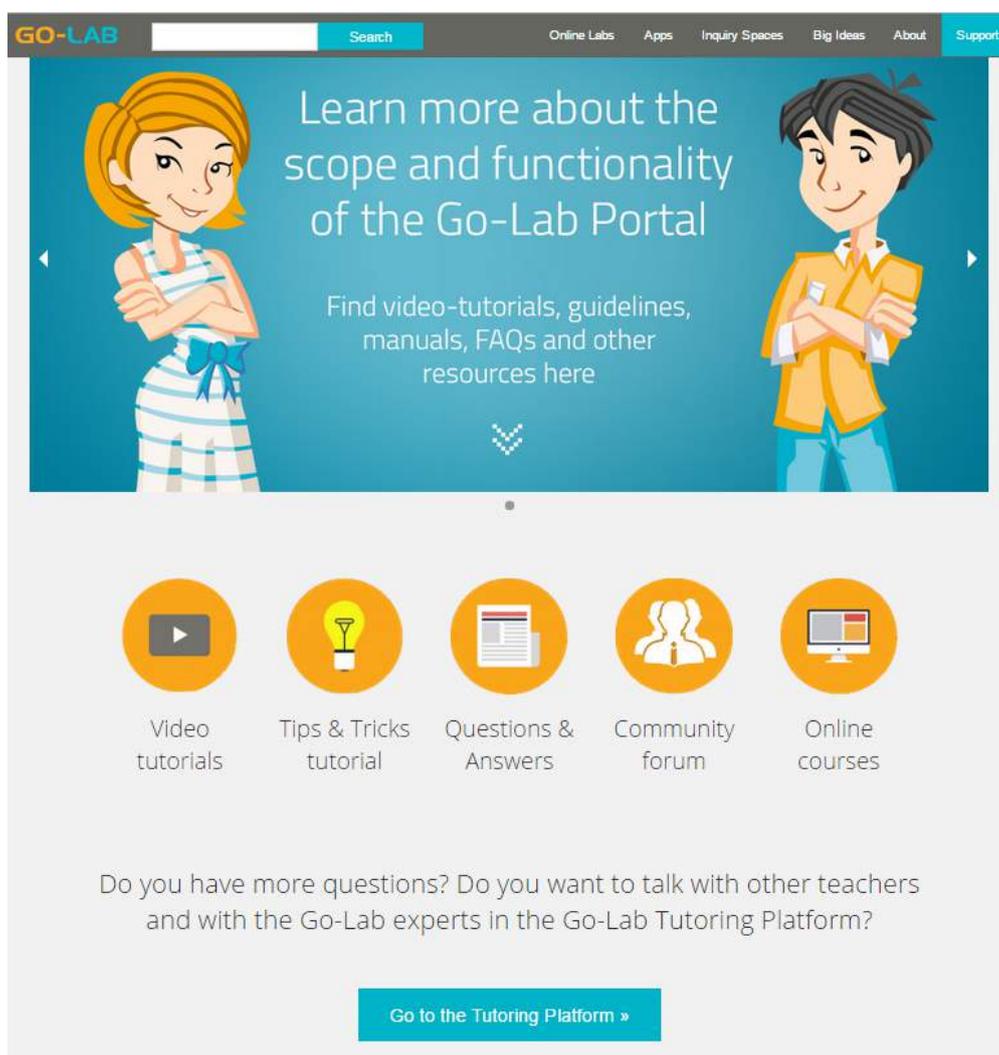
### 3.3.2 Support teachers virtual community building

Based on the review of Year 2 and Core Teacher Group's feedback (WP3), it is important 1) to involve the user communities to use the tutoring platform, and 2) to collaborate closely with other Go-Lab work packages. Thus, the road map specified in D4.6 is the guideline for this final release. We recall the road map in Figure 31 for the overview.

Based on this road map, cooperation work with other work packages has been making progress. We have introduced the tutoring platform to the core group teachers (CGT) at the participatory design workshops by Work Package 3. Cooperation is to be strengthened with Work Package 2 to develop detailed use scenarios with school teachers. Work Package 1 offers pedagogical approaches to conduct the tutoring session with the focus on content and experts. The community building activities on the tutoring platform contribute greatly to the work conducted in Work Package 6.

Moreover, the tutoring platform has been well linked to the Go-Lab Portal, which is reported in D5.6. Figure 32 Thus, the Go-Lab Portal users could find and join the teachers' community easily. More important, from the aspect of a business model for sustainability of the Go-Lab Tutoring Platform, teachers are trained and promoted to become tutors in certain knowledge domains themselves. Go-Lab experts are indispensable to impart the knowledge and offer professional trainings for STEM teachers. These sessions also enable teachers to become experts to offer tutoring sessions to other teachers, which is one of the main purposes of Go-Lab community building. The tutoring platform help teachers

break off on this professional development path for teachers' community.

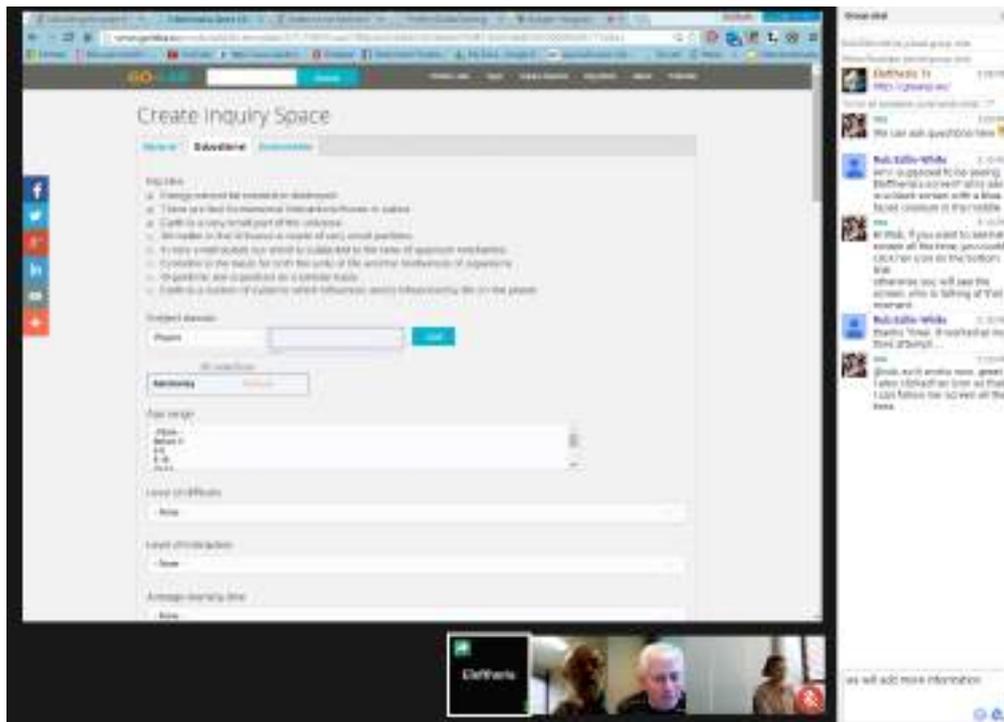


**Figure 32. The Tutoring Platform is listed in the Go-Lab Portal.**

To encounter the questions by the reviewers and teachers, since February 2015, many “real” sessions have been hosted on the tutoring platform. These sessions are not test sessions any more, but offered by Go-Lab consortium and booked by Go-Lab teachers or other Go-Lab partners. We report those sessions below.

### ***3.3.2.1 Roll-out: tutoring sessions for teachers' professional training***

The first four tutoring sessions were offered solely by the Go-Lab experts on the tu-toring platform, in order to tackle specific needs of the teachers like creating ILS and publishing them in Golabz. The first two sessions were organized in the framework of the Go-Lab 2015 contest. They aimed to demonstrate the Go-Lab services (Golabz and its components as well as the inquiry space authoring environment) to the contest participants. The sessions helped the participating teachers prepare their submission entries for the contest. The first tutoring session (Feb. 13th, see Figure 33) targeted teachers who had also attended the 2014 Go-Lab summer school. New features of the Go-Lab Portal were demon-

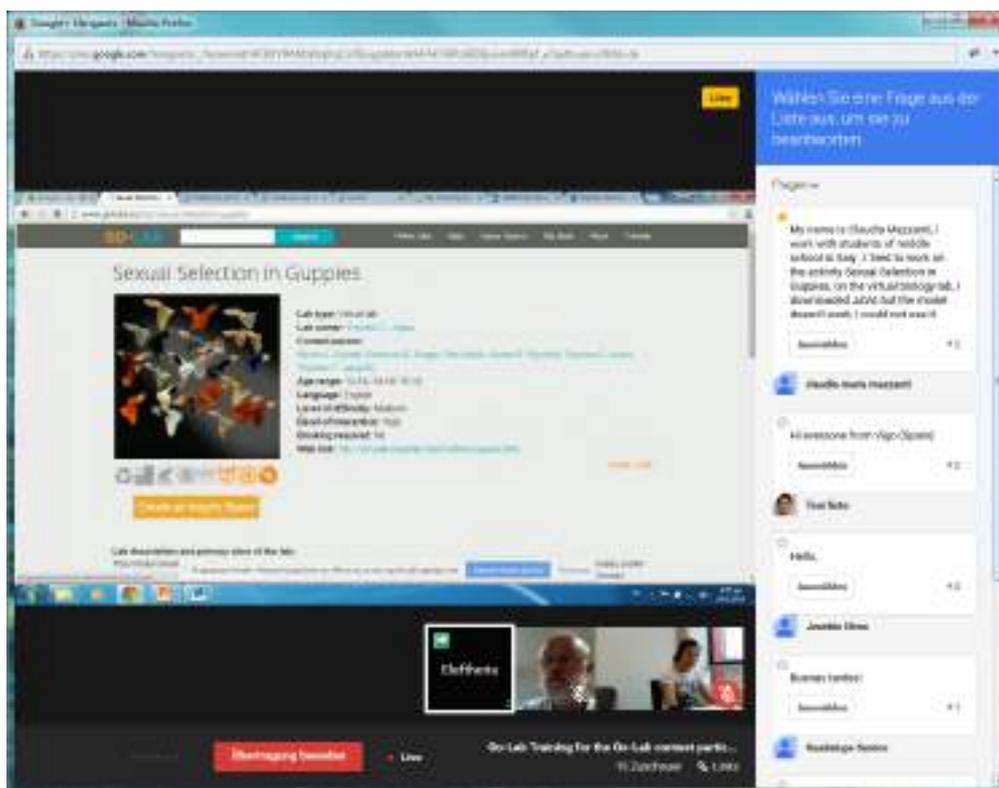


**Figure 33. The tutoring session on February 13th, 2015 (Google Hangouts).**

strated, in particular how to publish ILS which the teachers had prepared during the summer school.

The second tutoring session (Feb. 26th, see Figure 34) was the first webinar, a recorded session through Google Hangouts on Air. The Go-Lab experts demonstrated how to publish their work. Teachers asked about Java-enabled labs, how to use the inquiry space authoring platform, reuse resources in Moodle, etc. It indicated that the teachers had requests on support and these were clarified in the session. Moreover, the teachers did not check the tutorials available in Go-Lab Portal, but they chose to directly ask the tutors for support. After this session, participants sent no more e-mails to ask for help on publishing their ILS except two cases due to some technical system errors. In total, 35 contestants out of the 42 (83.3%) who submitted a valid entry had published an ILS. Below, some detailed statistics about this session are represented:

- 35 users registered on the tutoring platform after the session announcement
- 37 views on YouTube during the session time
- 17 views on Google Hangouts on Air (HOA) at the peak time
- 5 teachers out of the 17 viewers confirmed their attendance on the Google HOA event page and were active in asking questions during the session.



**Figure 34. The tutoring session on February 26th, 2015 (Google HOA).**

The third session (Apr. 13th) was organized in response to contest participants' e-mails requesting help in publishing their inquiry spaces. This session aimed to help the developers figure out the real problems the teachers have encountered during their ILS publishing process. Two technical experts took the tutor role: one for Golabz, the other for the inquiry space authoring platform. Five participants joined in, while two of them addressed their questions very frequently during the session. At the end, this session managed to solve some technical problems as well as to make participants familiar with the new features of the Go-Lab Portal. The fourth session (Apr. 15th) entitled "How to use Golabz Tutoring" was offered by the tutoring platform technical experts to help participants use the tutoring platform itself. Only two teachers have booked this session. Both of them addressed questions about the Go-Lab Portal instead of the tutoring platform. It showed that teachers grasp the opportunity to talk with the tutors about their use of the Go-Lab Portal and the problems they have met with.

### **3.3.2.2 Teacher's initiative session**

After the Go-Lab experts offered the four sessions, a Go-Lab pilot teacher from Spain initiated a tutoring session entitled "Stage Conceptualisation Terminology in Interactive" on Apr. 27th, 2015. This teacher had initially been introduced to Go-Lab in one of the dissemination activities in Spain in 2014. She participated in the 2014 Go-Lab contest and she later attended the 2014 Go-Lab summer school. Overall, she is a teacher who had already been actively involved in preparing and implementing inquiry activities using online labs. She decided to

make a tutoring offer after she attended one of the sessions that were carried out in the previous months. She was offered support by the project's team in order to prepare her session on inquiry learning methods. Although only two participants from the Go-Lab team attended this session, the recorded video has reached 16 views as of middle of June 2015. As an ICT teacher, she has also met some problems with the Google Hangouts tool, since it was her first time to use this Google service.

### 3.3.2.3 Teachers' evaluation

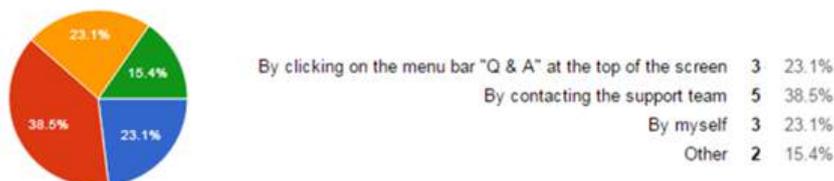
In all these five sessions three Go-Lab experts were present: one as a tutor, one as a moderator and technical supporter, while one observed and reacted at user feedback during the session. All participants were invited to attend the survey afterwards. The overview of five tutoring sessions is given in Table 1. There were 26 unique users who attended the sessions in total (some users attended more than one session). Above all, we found out that the teachers who attended the tutoring sessions were also active in attending the Go-Lab contests and Go-Lab summer schools, except of four users. Thirteen users also registered in the Go-Lab Portal in order to publish their ILS.

The survey consisted of nine questions assigned to two sections using Google Form . The first section contained general questions on conceptualisation and employment of the social tutoring platform for the Go-Lab Portal. The second section represented a usability test of certain features of the tutoring platform. Images were used to help teachers get illustrated memory of the platform. It took less than 15 minutes for the teachers / participants to fill in the questionnaires.

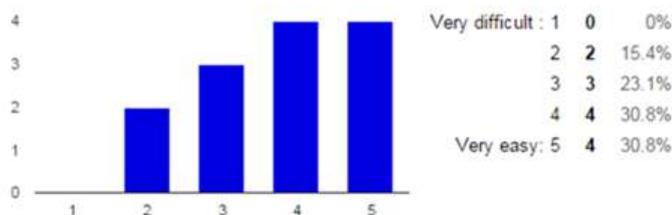
**Table 1. Overview of the tutoring sessions with the school teachers**

<b>Tutoring sessions</b>	<b>Tutor</b>	<b>Context</b>	<b>Pers. no. (excl. tu-tors)</b>	<b>Webinar - recorded</b>	<b>Survey pers. no.</b>
Feb. 13, 2015	Pedagogic experts	Contest	3	No	3
Feb. 26, 2015	Pedagogic experts	Contest	17	Yes	4
Apr. 13, 2015	Technical experts	Technical	5	No	3
Apr. 15, 2015	Technical experts	Tutoring Platform	2	No	2
Apr. 27, 2015	A school teacher	Teachers' initiative	2	Yes	2

## 2. How did you find out how to use the Tutoring Platform?



## 3. Is it difficult for you to understand the functionality of the Go-Lab Tutoring Platform [1 - difficult; 5 - easy]?



**Figure 35. Upper: The question on the support means of the tutoring platform Bottom: The question on the difficulty of use.**

Participants were asked which sessions they attended as presented in Table 1. The question on the ways of finding out how to use the platform (see Figure 35, upper) shows that most teachers contacted the Go-Lab team to figure out how to use the tutoring platform, though most of them graded the tutoring platform as “easy to us”, with four teachers saying very easy (30.8%), four saying easy (30.8%), and three saying average (23.1%). Only two out of thirteen graded the use as hard (15.8%) (see Figure 35, bottom).

Figure 36 shows that eight teachers confirmed the helpfulness of the tutoring platform for their further use of the Go-Lab Portal. This moderate reply reflects that the visibility and the usability of the tutoring platform still need some improvement. In association with the Question 2 (see Figure 5, upper), we assume that a user-friendly easy-to-use tutoring platform could encourage more users. In addition, most teachers were not familiar with Google Hangouts, which could lead to some negative rating of the easiness of the tutoring platform, though we observed the participants using the platform more smoothly in the latter part of the tutoring sessions.

Although no specific survey questions were addressed to teachers’ community building, the questions on incentives to help other teachers show interactions among teachers’ communities (see Figure 37). Eleven teachers rated both of the questions “Tutors get other tutors’ help sessions in return” and “Any user has the opportunity to become a tutor” as appropriate and very appropriate. Ten teachers agreed with the statement “teachers like sharing their experiences”.

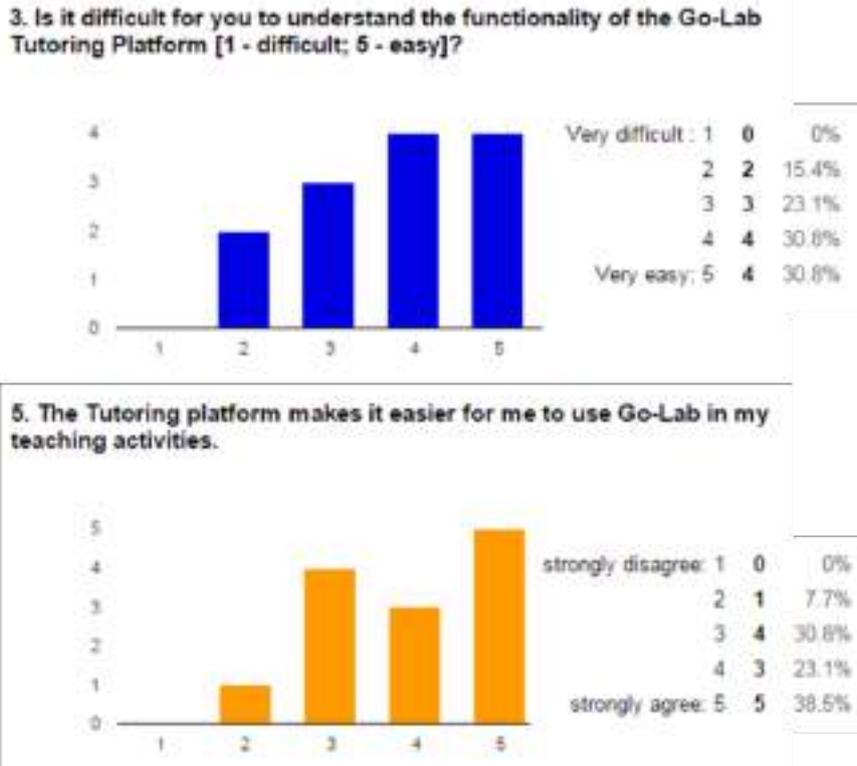


Figure 36. The question on the helpfulness of the tutoring sessions for the use of the Go-Lab Portal.

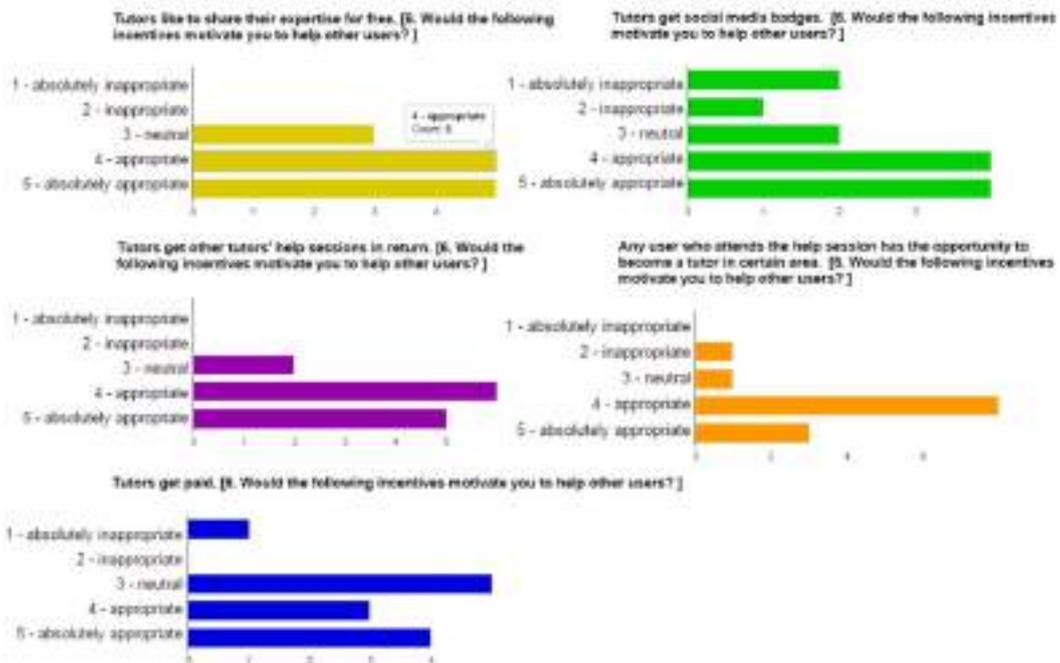
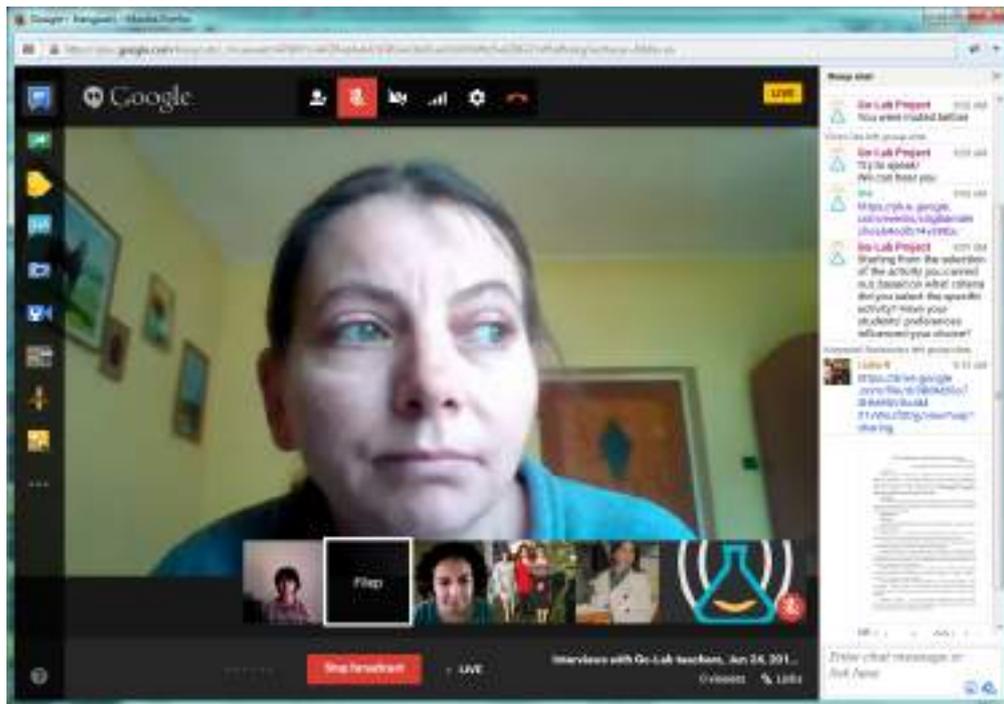


Figure 37. The question on the helpfulness of the tutoring sessions for the use of the Go-Lab Portal.



**Figure 38. A teacher is talking about her experiences with Golabz at Evita's interview.**

#### ***3.3.2.4 Teachers' interview sessions by EUN***

The interviews took place in June and July 2015. Figure 38 shows a screenshot of an interview with a teacher about her experiences with Golabz. The interview was organised as a video chat in Google Hangouts through the Go-Lab Tutoring Platform. More details can be found in the deliverable D8.4.

## 4 Conclusion

In this deliverable we have presented the final release for the learning analytics, scaffolding, and add-on services in Go-Lab based on the previous deliverable D4.6, the final specification.

The final release of the learning analytics and scaffolding services consists of both a variety of single learning analytics apps, as well as an infrastructure to be extendable and sustainable for future developments. Therefore, we deliver both the software and a developer documentation with tools to produce new learning analytics apps, services and agents that are built upon that infrastructure. In summary, these learning analytics approaches target the stakeholders teachers, students, lab-owners and researcher of the Go-Lab consortium.

The final releases of the add-on services are divided into two parts. The final release of the Go-Lab Booking System offers teachers the booking processes distributed in the Go-Lab Portal and Smart Gateway as well as Smart Devices. It also supports remote lab owners to manage their lab calendars. The final release of the Go-Lab Tutoring Platform has 156 registered users as of the middle of September, 2015. It included new features and approaches to support teachers' community building based on the requirements from the community building work package and other community requests. The most changes are: 1) it offers tutors to give their sessions as recordable Webinars; 2) it has hosted a community forum which is accessible from the Go-Lab Portal as well; 3) it offers more communication means between tutors and teachers like group email functionality and session request; 4) it is tightly associated to the Go-lab Portal through the support page at Golabz.

After this final release, more collaboration will be conducted with the Go-Lab community cluster to promote the tutoring platform (WP6, WP7). Also for the booking system, lab owners need be involved to create and manage their remote lab calendar (WP5).

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