Next-Lab

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

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Report on participatory design activities and adoption

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Executive Summary

This deliverable D4.1 gives an overview of the participatory design and user testing activities performed on apps, labs, Inquiry Learning Spaces (ILSs), Go-Lab system infrastructure (e.g. ILS publishing or help and support facilities), and processes (e.g. peer assessment procedure) in the first eight months of the Next-Lab project. The goal of Participatory Design (PD) is to actively include end-users in the design process to not only design for them, but with them. For example by critiquing existing designs and proposing redesign ideas, end-users can make their voices heard and directly shape the design outcome. The resulting improvement suggestions are presented to the developers and other project partners concerned to support their redesign of software applications and other project activities.

After an introduction in Section 1, Section 2 describes basic concepts pertaining to Participatory Design, which is the backdrop of the work presented in this deliverable, followed by a description of the approaches and methods applied in the PD sessions.

Section 3 gives an overview of the three major types of PD studies performed, namely face-to-face, remote, and analytical studies. The individual activities performed with each type of PD study, targeting various Next-Lab elements (e.g. GoModel app, Seesaw Lab, General ILS design, registration process), are then described in detail in Section 4, 5, and 6, respectively.

Section 7 presents the results of the PD activities aggregated by artefacts under evaluation, enabling the developers of the artefacts to access the related findings efficiently. Major themes being observed in all or some of the sessions are identified in Section 8.

Section 9 describes the adoption of the findings by developers and of the Go-Lab artefacts by teachers. Facilitating and hindering factors for teacher adoption, as derived from the empirical data of the PD studies, are discussed.

The deliverable is then concluded (Section 10) with a plan for future PD activities in Next-Lab.

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1. Introduction

To attain the goals of Next-Lab - providing more resources for primary school students and teachers, including pre-service teachers as a dedicated target group, and fostering learners' 21st century skills - enhancements and extensions of the existing Go-Lab components and resources are necessary. The main purpose of the participatory design (PD) activities in the Next-Lab project is to ensure that such enhancements and extensions are not only useful and usable, but also desirable and pleasurable for end-users.

In comparison to Go-Lab, where a work package (WP) was dedicated to planning, conducting, and analysing PD activities, in Next-Lab the PD activities are more interwoven with the other WPs. As of August 2017, there are 1146 components on the Go-Lab sharing platform (484 labs, 620 ILSs and 42 apps). Attempting to evaluate all or even a wide range of them would result in rather superficial findings. Since we aim to make the best use of the resources allocated to the PD work to yield findings that have direct and valuable impacts on the ongoing development of the project, we adopt an *on-demand* approach to provide timely feedback to the project partners concerned; most of them are developers but we also support pedagogical specialists with our work.

Specifically, the Next-Lab partners can approach the PD team with their requests, specifying the artefact to be evaluated, its potential target groups, and by when findings are needed. Alternatively, partners can enter such requests into an online document (i.e. "wish list": http://tiny.cc/pd-nextlab-wishlist) maintained by the PD team comprising specialists in the field of Human-Computer Interaction (HCI). Upon receiving the requests, the PD team will design suitable PD studies in collaboration with the partners concerned to ensure that the outcomes of the studies will meet their needs.

With the requests of the project partners, a series of workshops with a variety of stakeholders (students, pre-service and in-service teachers, and teacher trainers) and stakeholder surrogates (HCI researchers assuming the role of teachers and students) have been performed in the context of the Next-Lab project. Individual workshops have been tailored to address the specific characteristics of the artefact evaluated and to participants, venue, time constraints, and information needs of the partners. Tailoring the events included not only selecting an appropriate PD approach (face-to-face, remote, or analytical) but also creating customised protocols for each session, based on a general structure proven effective in the context of the Go-Lab project (Law, 2015). After performing the studies, the PD team analysed the results and reported the findings to the Next-Lab partners, who would then decide how to adopt the findings to improve the Go-Lab system. For the more recent PD studies (e.g. the activities at the Next-Lab Summer School 2017 in July) this deliverable reports the findings so that the corresponding partners can decide how to handle the emerging requests; the impact of these findings will be reported in future deliverables.

This deliverable D4.1 gives an overview of the aforementioned studies, which have been performed during the first eight months (January to August 2017) of the Next-Lab project. Each study is then described in detail to explain the data gathering process leading to the findings for each Next-Lab artefact evaluated. By reflecting on the findings aggregated from different PD activities, we identified some facilitating and hindering factors for adopting the Go-Lab components from the end-user perspective and discussed their implications for the subsequent work of Next-Lab.

2. Participatory Design (PD) Approaches

2.1 Basic concepts

Participatory Design (PD) is a broad research area in the field of Human-Computer Interaction (HCI) with the main goal of actively including end-users in the design process of products and services. PD has its roots in a Scandinavian movement to democratize the workplace in the 1960s (Asaro, 2000). Since then the idea of actively involving end-users in the design process has been applied to a great variety of artefacts and systems. The diversity of targets for PD entails various approaches, methods, and tools (Clement & Van den Besselaar, 1993; Schuler & Namioka, 1993; Muller, 2007; Sanders, Brandt, & Binder, 2010; Walsh, Foss, Yip & Druin, 2013; Halskov & Hansen, 2015). The main goal of including end-users actively in the design process is to tailor the system under development to their needs and expectations, so they can enjoy good usability and positive user experience when interacting with the final product/service.

A concept akin to PD is 'usability' of which the formal definition is: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use." (International Organization for Standardization [ISO], 1998). A product can be a digital artefact, such as website and software application (e.g., the Go-Lab sharing platform, the Graasp authoring environment, apps and labs in Next-Lab). While usability focuses on the artefact and performance measures of human-computer interaction, e.g. pragmatic quality and do-goals, User Experience (UX), as a research area, is primarily concerned with the experiential aspect from the end-user perspective, e.g. hedonic quality and be-goals (Hassenzahl, 2008; Law et al., 2009). Nonetheless, to attain high usability and positive user experience a plethora of approaches, methods and tools, grounded in research methods in HCI, are available (Lazar et al., 2017; Vermeeren et al. 2010). For the PD activities in Next-Lab, we carefully select the relevant ones to serve the needs of the project.

To make the appropriate selection from the toolkit of HCI approaches, it is imperative to have clear specifications of requirements for user-based evaluation studies (i.e. inputs from the Next-Lab project partners) and in-depth understanding of strengths and weaknesses of different HCI approaches (i.e. the expertise and experience of the PD team). In the following sections, we present the HCI approaches selected for the PD activities in Next-Lab. Apart from making educated selections on which approaches are best suited for the situation at hand, the PD team, with their knowledge of both worlds can mediate between end-users and developers. For example, they can translate the jargon developers sometimes use into everyday terms with which end-users are familiar or pass on end-users' wishes with appropriate technical terms to developers.

2.2 Approaches

Three types of PD approaches have been employed in Next-Lab: face-to-face user studies, remote user studies, and researcher-based analytical evaluations.

2.2.1 Face-to-face user Studies: Workshops and Events

Participatory Design is most commonly conducted via face-to-face workshops where end-users, researchers, and designers are brought together to generate ideas for new artefacts and re-design existing ones. Depending on the artefact under evaluation as well as on the participants, venue, and contextual characteristics of a workshop, different paper-based methods (e.g. questionnaires, booklets, sticky notes activities) or a software-supported PD

approach (PDotCapturer (Heintz, 2017), see Section 2.2.4) were selected to gather input from students and teachers (see Table 2 and Section 4 for details).

Although face-to-face PD activities generate a productive environment to gather ideas and therefore result in rich feedback, they have some shortcomings from the project perspective. It can be time-consuming to find the right schedule for all stakeholders in the PD activities and therefore it can take time between planning the activity and actually having the findings ready for the partners concerned. To substantiate results from face-to-face workshops with additional data and in cases where a quick response to the partners was required, we used alternative approaches to face-to-face sessions: remote studies and analytical studies.

2.2.2 Remote User Studies: Next-Lab Core Group and PD Teachers

In the Go-Lab project, a group of 21 enthusiastic teachers, who were keen to contribute to the development of the project, were recruited as “Core Group Teachers” (CGT). They were asked to perform dedicated online tasks with specific Go-Lab artefacts and concepts and then provide feedback. As communications were conducted remotely via the Internet, CGT could provide their input efficiently, independent of the geographical and time constraints. Given the positive experiences of working with the CGT, the “Next-Lab core group and PD teachers” group was created (“Next-Lab” was added to the group name to reflect the new project and “and PD” was added to clarify their main purpose), consisting of some established Go-Lab core group teacher members and some interested new teachers with varying degrees of experience with the Go-Lab system. Tasks are sent to this group of seven teachers from different countries across Europe via email on a bi-weekly basis (see Table 3 and Section 5 for details). Depending on the evaluation target, the tasks can vary, including filling in a questionnaire, providing ratings in a spreadsheet, and giving feedback with PDotCapturer.

In contrast to face-to-face workshops, where feedback is given in a dedicated time-slot, the CGT undertake the given Next-Lab tasks alongside their own teaching duties. An issue with the remote approach can therefore be the fluctuating response rate, depending on the current workload of the individual member of the CGT. As a consistent source of reliably quick feedback, with the drawback of not having actual end-users involved, we therefore sometimes perform researcher-based analytical evaluation studies.

2.2.3 Researcher-based Analytical Studies

In cases where it was not possible to gather feedback from end-users in time, a researcher-based analytical evaluation approach was applied (see Table 4 and Section 6 for details). In these cases, the PD team used their expertise in HCI and experience of working with end-users from the target groups to evaluate an artefact. The researchers perform a walkthrough of the system, meaning that they inspect all aspects from two perspectives. On the one hand, they check if there are any general violations of widely used usability heuristics (e.g. Nielsen’s (1994) 10 Usability Heuristics; one of which is: ‘Match between system and the real world’) in the interface. On the other hand, they assume the role of an end-user performing common target tasks with the system to identify possible usability issues.

When composing a final report as the outcome of an analytical study, the issues identified by the HCI specialists are usually rated according to the importance of fixing them, thereby improving the usability and user experience of the evaluated artefact. To improve the reliability of the rating it is usually done by several HCI specialists and discrepancies are discussed to reach consensus:

- Low importance (L) rating is given for issues, which would be noticed by end-users, and might affect their overall sense of the quality of the interface, but would not hinder them significantly in achieving their objectives.
- Medium importance (M) rating is given for issues, which would be noticed by end-users and may confuse, delay or distract them briefly and temporarily.
- High importance (H) rating is given for issues, which would be an obstacle for end-users, either preventing them from achieving their goals, or causing significant delay, disruption, confusion or annoyance.

Table 1 shows an excerpt of the list of usability observations of the SpeakUp app identified during an analytical study of the Seesaw Lab (Event Id: LEIC-22062017b, see Appendix R for the full table). It shows the recommended modification for each usability observation made when interacting with the SpeakUp app. In the rightmost column, the importance rating is specified to let the developers know how urgent each issue should be fixed.

Table 1. Excerpt of the list of usability observations of the SpeakUp app identified when evaluating the Seesaw Lab example ILSs (one ILS allowing to interact with only the left side and the other one allowing to interact with only the right side of the seesaw in the Seesaw Lab)

	Usability Observation	Recommended Modification	Import-ance
1	SpeakUp does not work in Internet Explorer (input box is nearly completely invisible and impossible to use). 	Make the SpeakUp app work properly in all major browsers.	**H**
2	There is a red border around the input box when it is empty (in Firefox), making it look like there is an error. 	Remove red border.	**L**

	Usability Observation	Recommended Modification	Import-ance
3	After sending a message the user has to click into the input box to type the next message.  Several times this caused confusion with the user starting to type the next message after sending one, only to realize halfway through the sentence, that the typed message did not appear in the input box.	After sending a message, the cursor should automatically reappear in the input box so that the user can continue chatting without having to manually click in the box again.	**M**
…			

2.2.4 PD Tools: PDotCapturer

PDotCapturer is a tool developed for end-users to provide input and feedback (Heintz, 2017). It can be used in face-to-face or remote settings to elicit feedback.

In Figure 1, PDotCapturer is displayed while being used to gather end-user ideas and comments on GoModel[1]. Details on this study can be found in Section 4.3 and 7.1.1. The left hand panel and upper right panel are PDotCapturer and the lower (bigger) area is the GoModel tool itself. The tool integrated into PDotCapturer is fully interactive so that users can explore it. If the user wants to comment on a specific object on the user interface, switching into feedback mode (in which the tool to be evaluated is no longer interactive) by pressing a button is necessary. By clicking on the object to comment, or anywhere else on the screen, a marker will then be created to indicate the position of the comment. A yellow post-it icon will appear and the end-user can provide a textual description in the text box in the left panel. Additionally, the cursor can be used as a free-hand drawing tool, for example, to cross out existing objects, sketch a new element, and so on. Besides, the user can indicate the emotional response to the current design by selecting one of the smiley icons.

[1] http://www.golabz.eu/apps/gomodel

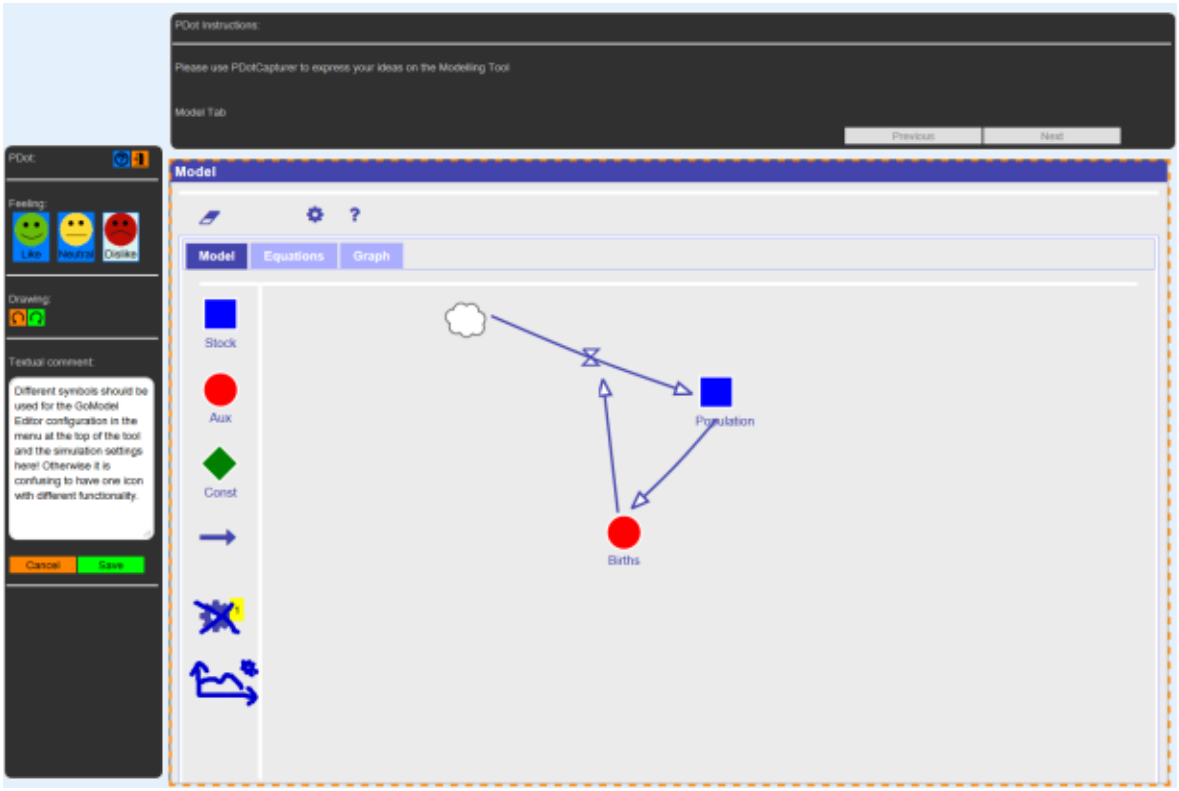

Figure 1. PDotCapturer, in this example screenshot used for collecting feedback on GoModel

3. Next-Lab Year 1 PD and User Studies

The Next-Lab PD and user evaluation activities collected feedback and input from over 70 teachers (or pre-service teachers) and over 65 students. Altogether, 21 sessions were performed: 13 face-to-face PD sessions (see Table 2 for an overview and Section 4 for details), 4 remote studies (see Table 3 for an overview and Section 5 for details), and 4 analytical studies (see Table 4 for an overview and Section 6 for details).

Table 2. An overview of face-to-face PD studies in the first eight months of the Next-Lab project (*the study has been carried out by the University of Cyprus [UCY])

Event ID	Date	Location	No. of participants	Comments / components covered
LEIC-23022017	23/02/2017	University of Leicester	31 pre-service teachers	Next-Lab project and Go-Lab resources in general
LEIC-27022017	27/02/2017	University of Leicester	12 pre-service teachers; 1 teacher-trainer	Next-Lab background, ILS student experience, Go-Lab sharing platform, ILS authoring and publishing, GoModel tool
LEIC-03032017	03/03/2017	University of Leicester	16 students	GoModel tool
LEIC-23032017*	23/03/2017	(University of) Cyprus	48 responses from pre-service teachers	Help and support (questionnaire sent out via email after face-to-face training)
LEIC-06052017a	06/05/2017	Brussels	16 teachers	Help and support services, Graasp registration process
LEIC-06052017b	06/05/2017	Brussels	16 teachers	Peer-assessment, keywords, chat
LEIC-13062017	13/06/2017	University of Leicester	2 teacher trainers	Next-Lab project and Go-Lab resources in general, scenario integration, ILS publishing process
LEIC-22062017a	22/06/2017	University of Leicester	28 pre-service teachers; 2 teacher trainers	Next-Lab project and Go-Lab resources
LEIC-27062017	27/06/ & 28/06/2017	University of Leicester	4 students (2 each day)	SpeakUp app, Seesaw Lab, ILS design
LEIC-11072017a	11/07/2017	Marathon	24 teachers	LA apps in general
LEIC-11072017b	11/07/2017	Marathon	24 teachers	Individual LA apps
LEIC-11072017c	12/07/2017	Marathon	24 teachers	ILS publishing process
LEIC-11072017d	14/07/2017	Marathon	24 teachers	Scenario integration

Table 3. An overview of remote studies in the first eight months of the Next-Lab project

Event ID	Date	Components covered
LEIC-00032017	03/2017	Keywords
LEIC-23062017	23/06/2017	Apps
LEIC-07072017	07/07/2017	Chat
LEIC-04082017	04/08/2017	Scenario integration

Table 4. An overview of analytic studies in the first eight months of the Next-Lab project

Event ID	Date	Components covered
LEIC-22052017	22/05/2017	ILS publishing process
LEIC-30052017	30/05/2017	Apps
LEIC-22062017b	22/06/2017	Seesaw Lab
LEIC-03072017	03/07 & 04/07/2017	Viewer app

Most of the formal PD events were conducted by the PD team at the University of Leicester, UK. The following sub-sections give an overview of the studies performed. Details are then presented in Section 4, 5, and 6 (chronologically). The results are not presented in conjunction with each study, but grouped by the artefact evaluated, to enable developers and partners interested in the outcome to quickly identify all the findings relevant for them.

4. Face-to-face Participatory Design Studies: Events

4.1 Next-Lab Taster Session for Pre-service Teachers (LEIC-23022017)

A half-hour taster session for 31 pre-service teachers was held at the University of Leicester on 23/02/2017. In this session, the participants were introduced to the concept and objectives of Next-Lab. The explanatory introduction was followed by some demos of selected artefacts representing the range of resources available on the Go-Lab sharing platform: apps (Concept Mapper, Hypothesis Scratchpad), labs (Impact Calculator, Gear Sketch, Electricity, Guppies, etc.), and ILSs (Craters on Earth). During a short discussion following the presentation, the pre-service teachers provided qualitative feedback on their impression of the Next-Lab project and whether and how they could see an application of Next-Lab as part of their upcoming school placement. No actual PD data was gathered in this session, it was mainly used as an introduction and recruitment event for further studies.

4.2 Hands-on Next-Lab Workshop for Pre-service Teachers (LEIC-27022017)

Out of the 17 people who showed interest in attending, there were 12 pre-service teachers and 1 teacher-trainer present for this two-hour session conducted on 27/02/2017. It started with a brief revision of the project's background and benefits, followed by some hands-on experience with the "Craters on Earth (and other planets)" ILS, the Go-Lab sharing platform, the Graasp authoring environment and the ILS publishing process. Finally, for the evaluation of the GoModel tool, a live demo was first presented, followed by a video tutorial and an explanation of its purpose. Using a link to the tool, participants were able to freely explore it for a few minutes before providing their feedback. Input from participants was gathered throughout the session using observer notes and worksheets (see Section 7.1.1 and Appendix A).

4.3 PD Workshop with Students on the GoModel Tool (LEIC-03032017)

On 03/03/2017 the ULEIC team performed a two-hour PD workshop with 16 university students to gather PD ideas on the Model and Graph tab of GoModel. Based on a frozen version of GoModel[2] a PDot event[3] was created to gather PD ideas on the Model tab and the Graph tab in the tool. As an introduction, the participants first watched a tutorial video on GoModel[4], followed by a step-by-step presentation of the part of the video showing how to create a 'stock' and an 'aux' variable. While the students followed along with the video (paused several times for the students to interact with GoModel and to provide feedback), they were asked to express their ideas using PDotCapturer. Aditionally, feedback from the students was captured using a questionnaire. The results of this workshop are presented in Section 7.1.1.

4.4 Go-Lab Support/Help Services questionnaire with pre-service teachers after face-to-face training (LEIC-23032017)

To evaluate the Go-Lab system infrastructure providing help and support information and functionality the UCY team shared the Go-Lab Support/Help Services questionnaire with 26 graduate (master) and 67 undergraduate pre-service teachers (bachelor in primary education) of the Department of Education, who were trained to use the Go-Lab Ecosystem

[2] http://go-lab.gw.utwente.nl/experiments/2017-02-PdGoModel/tools/gomodel/src/main/webapp/gomodel.html

[3] https://campus.cs.le.ac.uk/tomcat/PDotV09/?locale=en&pdot_view=DEVELOPER&eventId=81

[4] https://www.dropbox.com/s/1dwyftvyx3zucl6/gomodel_tutorial.mp4?dl=0

and they created their own ILSs. The aim of the questionnaire was to collect information from expert users of the Go-Lab ecosystem (details on the training they received can be found in Appendix B) concerning the support services. The call for the questionnaire was done through email in which the users were informed about its purpose and the importance of having their comments and suggestions for improving the support/help services system of Next-Lab. In total 48 responses were received, the results of which are presented in Section 7.4.8.

4.5 Ambassadors Workshop in Brussels (LEIC-06052017a & b)

The weekend event from 05/05 to 07/05/2017 was attended by 16 of the 18 ambassadors recruited for the Next-Lab project by then. The workshop contained several different PD sessions of varying length aimed to collect feedback on four main topics: help and support services, registration process on Graasp authoring environment, peer-assessment tool and process, and keywords. Two methods were used to collect feedback regarding the support services and registration process on Graasp. One of them was the use of an online questionnaire, and the second method incorporated a more interactive approach where teachers could read and make annotations on the printouts of the agreement forms presented when signing up in the Graasp authoring environment, joining the community or joining an event. Their notes were then used for further discussion with the group. The part of the session dedicated to peer-assessment started with a concept map assessment game to get the teachers thinking about assessment criteria, followed by an introduction to the purpose and process of peer assessment and rationale for adding it to Next-Lab. Then the participants received a live demonstration of the tool showing the following features:

- The interface for students to request peer assessment of a hypothesis
- The facilities for teachers to assign a student to perform the assessment
- The notification shown to the student who was assigned to perform the assessment
- The interactions of the student performing the assessment
- The notification shown to the student who initially requested peer assessment once the assessment has been performed.

For the peer-assessment evaluation, the participants used coloured post-it notes to provide feedback on four main areas:

- Green to specify for what students it would be most appropriate;
- Pink for improvement ideas and suggestions;
- Yellow to name the main benefits expected from both the app and the process;
- Orange to state any concerns participants could have about using peer-assessment in the classroom.

An online questionnaire was used to collect feedback about keywords and a mix of hands-up questions followed by a facilitated discussion was applied for collecting opinions about possible new chat functionalities. Besides specific results and findings with regard to the Go-Lab system infrastructure components (keywords (see Section 7.4.1), peer-assessment (see Section 7.4.2), chat (see Section 7.4.4), registration process on Graasp authoring environment (see Section 7.4.7), and help and support services (see Section 7.4.8)), the activities at the Ambassadors workshop in Brussels also lead to general feedback presented in Appendix C.

4.6 Twilight Session with Teacher Trainers (LEIC-13062017)

To gather further insights from pre- and in-service teacher perspective, a twilight session (event in the late afternoon to allow people to join after work) for teachers and teacher trainers was conducted at the University of Leicester on 13/06/2017 from 16:00 to 18:30. The two participants were given a short PowerPoint presentation containing background information on the Next-Lab project and its software system. After exploring the Go-Lab sharing platform and its resources, they provided feedback on the scenario integration in the sharing platform using PDotCapturer (see Section 7.4.5 for results) and ILS publishing process (see Section 7.4.6 for results). In the process of exploring the Go-Lab resources, the participants also provided comments on the ILS design (see Section 7.3).

4.7 Next-Lab Feedback Workshop for Pre-service Teachers (LEIC-22062017a)

Twenty-eight pre-service teachers (plus two teacher trainers) attended a Next-Lab refreshing session at the University of Leicester on 22/06/2017 from 11:30 am to 12:15 pm. The purpose of this session was to converse with recently involved pre-service teachers about their experience, future possibilities and personal engagement with the Next-Lab project. After a short refresher presentation on the Go-Lab resources, participants were divided into three groups for a 5-10 minute discussion of three sets of questions regarding the usage of the Go-Lab resources, potential collaboration, and planned usage in the future (for details on the questions and responses, see Appendix D). Three researchers covered one set of questions each and moved from group to group, so that each group answered all three sets of questions during the session.

4.8 End-User Evaluations of the Seesaw Lab (LEIC-27062017)

On 27/06/2017 (15:00 to 16:05) and 28/06/2017 (16:30 to 17:50) the ULEIC PD team performed an evaluation of the Seesaw Lab[5] with end-users to evaluate its overall usability and user experience and to identify possible obstacles when using it. Besides the Seesaw Lab, this evaluation also covered the SpeakUp app, because it is included in the example ILSs for the Seesaw Lab, demonstrating the remote collaboration of two students using only SpeakUp to communicate. These example ILSs are provided by the Seesaw Lab developers to try out the lab and have thus been used to evaluate it. Due to the time constraint, it was not possible to get hold of school students, the evaluations were thus performed with the help of Informatics PhD students. The four participants without prior knowledge about Go-Lab / Next-Lab or SpeakUp, and the Seesaw Lab were split into two pairs to experience the remote collaboration of students working through the example phase of the ILSs presented on the Go-Lab sharing platform. One of the students worked solely with the left side Seesaw Lab and the other solely with the right side (details can be found in Appendix E). Think-aloud and observations were used to identify possible issues but also positive aspects of the ILS and the included elements. The two sessions with end-users resulted in useful data on the SpeakUp app (see Section 7.1.2), the Seesaw Lab (see Section 7.2), and ILS design in general (see Section 7.3).

4.9 Next-Lab Summer School 2017 (LEIC-11072017a & b & c & d)

The Next-Lab Summer School 2017 was a six-day event for 24 teachers in Marathon, Greece from 09/07 to 14/07/2017. The main purpose was to educate the teachers by giving presentations about pedagogical concepts, the Next-Lab project, and new Go-Lab

[5] http://www.golabz.eu/lab/seesaw-lab

resources and letting the teachers create an ILS in groups. Additionally, this event was used to gather feedback on different aspects of the Go-Lab system. General observations were made and recorded over the whole course of the Summer School. In addition, there were dedicated sessions of different duration to collect PD feedback:

- On general aspects of Learning Analytics apps (LA apps) using questionnaires (LEIC-11072017a, see Appendix F for details and Section 7.1.4 for results)
- On issues in specific LA apps by performing a sticky notes group activity (LEIC-11072017b, see Appendix G for details and Section 7.1.5 to 7.1.16 for results)
- On the Go-Lab system infrastructure enabling teachers to publish their ILS (publishing process) using a paper booklet (LEIC-11072017c, see Appendix H for details and Section 7.4.6 for results)
- On the Go-Lab system infrastructure presenting scenarios and allowing teachers to create an ILS based on them (scenario integration) using PDotCapturer (LEIC-11072017d, see Appendix I for details and Section 7.4.5 for results)

The activities on LA apps were performed in collaboration with EPFL, who provided a 1.5h hour training on the different apps to enable the participants to provide feedback.

5. Remote Studies: Next-Lab Core Group and PD Teachers Tasks

5.1 Keywords (LEIC-00032017)

When an artefact is added to the Go-Lab sharing platform a variety of meta-data can be specified. One of them is a set of keywords related to the artefact. This information could be collected for different types of artefacts (apps, labs, or ILSs) and made visible on the Go-Lab sharing platform or only be used in the background, for example to retrieve matching results for a search.

To gather end-user input on the different options available, a task to evaluate the keywords infrastructure in the Next-Lab system by filling out a questionnaire was sent out to the Next-Lab core group and PD teachers at the end of March 2017. The email sent to the participants is attached in Appendix J. The results gathered from the eight participants responding to this activity are presented in Section 7.4.1.

5.2 Suitability of Apps for Younger Students (LEIC-23062017)

A task to evaluate the suitability of the existing apps for the target group of primary school students, which is newly focused on in the Next-Lab project, compared to Go-Lab, was sent out to the seven Next-Lab core group and PD teachers on 23/06/2017. They were asked to rate the ease of use and understandability of the existing apps for younger students (aged 8-11 years old), specify the age-range they think the app is suitable for (from 6 up to 18 years old), and give an assessment if this app is for students and/or teachers. Details on this task can be found in Appendix K (the email with the task description) and Appendix OO (the questions and detailed results), the findings derived from the four teachers responding to this task are presented in Section 7.4.3.

5.3 Chat (LEIC-07072017)

To gather input on the question which infrastructure would be best for the planned chat functionalities in Next-Lab (e.g. having a dedicated chat app to be added by teachers in a specific position of their ILS or a global chat, which is always visible), a questionnaire was created in collaboration with the technical partners working on the 21st century skills apps. The task to fill in this questionnaire was sent out to the seven Next-Lab core group and PD teachers on 07/07/2017 (see Appendix L for the email).

Apart from sending the questionnaire to the Next-Lab core group and PD teachers, the invitation to take part in the survey was advertised through the Next-Lab social media channels (e.g. Facebook and Twitter) to gather feedback from teachers (Figure 2).

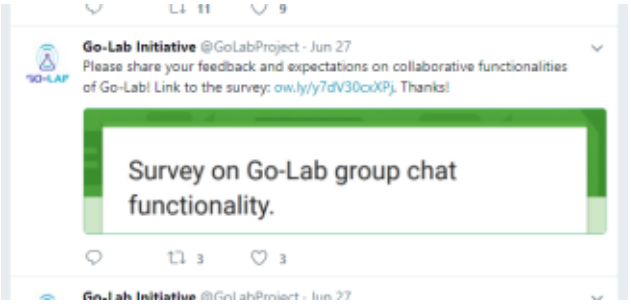

Figure 2. Tweet promoting the chat questionnaire

The results of the five participants responding to the questionnaire activities are reported in Section 7.4.4.

5.4 Scenario Integration (LEIC-04082017)

The activity performed at the Next-Lab Summer School 2017 (LEIC-11072017d, see Section 4.9 and Appendix I) was reused for the seven Next-Lab core group and PD teachers, to collect additional feedback regarding the scenario integration in the Go-Lab sharing platform and Graasp authoring environment. The task to evaluate the scenario integration using PDotCapturer was sent to the Next-Lab core group and PD teachers on 04/08/2017 (see Appendix M for the email). The findings derived from the feedback of the two teachers responding to this task are presented in Section 7.4.5.

6. Analytical studies

6.1 ILS Publishing Process (LEIC-22052017)

As requested in the PD wish list[6], the PD team performed an analytical walkthrough of the Go-Lab system infrastructure providing ILS publishing functionality to evaluate overall usability and user experience and to identify possible reasons for common mistakes while publishing ILSs on 22/05/2017 from 14:30 to 18:15. Three reviewers imagined themselves in the teacher role, being aware of a wide range of computer expertise among teachers, and assuming fair knowledge of the Next-Lab project and Go-Lab system. Detailed notes were taken to identify any usability obstacles, which might limit the ability of the teachers to publish an ILS. Some observations pertaining to user experience such as the aesthetic and affective factors were also taken into account. The results can be found in Section 7.4.6.

6.2 Suitability of Apps for Younger Students (LEIC-30052017)

An initial assessment of the apps regarding their suitability for younger students was performed by the PD team from the HCI perspective. To add the pedagogical perspective as well, three pedagogical experts were asked to contribute their ratings. The factors measured for each app were: usability (how easy or difficult it is to use), understandability (how well would students comprehend the concepts behind the apps), age range (suitable for what group ages), and whom it was designed for (i.e. students and/or teachers). The results of this activity can be found in Section 7.4.3.

6.3 Seesaw Lab (LEIC-22062017b)

On 22/06/2017, the PD team conducted a two-hour analytical walkthrough of the Seesaw Lab[7] to evaluate overall usability and user experience and to identify possible obstacles when using the Seesaw Lab. During this walkthrough, three HCI specialists explored and analysed the lab description on the Go-Lab sharing platform[8] and the left[9] and right[10] side Seesaw ILS examples. As the Seesaw Lab is aimed at pairs of students, only two of them actively interacted with the lab(s) while the third observed, provided interaction ideas or proposed things to try, and indicated issues she noted.

As teachers are the target group of this information on the Go-Lab sharing platform, the researchers assumed the role of a teacher planning to use this lab in their lessons when reading the instructions for the lab. While using the example ILS and the Seesaw Lab included, the researchers assumed the role of students working with this online lesson and lab (see Appendix N for details). This analytical study yielded results on the SpeakUp app, as it enables remote communication, which is an integral part of the remote collaboration promoted through the Seesaw Lab (see Section 7.1.2) and the Seesaw Lab itself (see Section 7.2).

6 http://tiny.cc/pd-nextlab-wishlist

7 http://www.golabz.eu/lab/seesaw-lab

8 http://www.golabz.eu/lab/seesaw-lab

9 http://graasp.eu/ils/5943d68616d1ef2147b8a209/?lang=en

10 http://graasp.eu/ils/5947b78916d1ef2147c666da/?lang=en

6.4 Viewer App (LEIC-03072017)

The PD team performed an analytical walkthrough of the Viewer app[11] on 03/07 (about two hours) and 04/07/2017 (one hour) in order to evaluate its overall user experience and to identify possible usability problems while using the app. The team went through the process of adding and using the Viewer app as part of an ILS. The findings of this activity are presented in Section 7.1.3.

[11] http://go-lab.gw.utwente.nl/sources/tools/viewer/src/main/webapp/viewer.xml

7. Results

The evaluation results presented subsequently are grouped into four clusters: Apps, Labs, ILS, and Infrastructure components. For each entity evaluated, selected rather than full-fledged results are highlighted to ensure the readability of the report. Details are provided in the signposted Appendices. Note that, unless otherwise stated, the reported mean ratings are referenced on a five-point Likert scale with 1 being the lowest and 5 highest on the respective attribute.

7.1 Apps

7.1.1 GoModel

The following section presents the aggregated results from the twelve worksheets returned during the hands-on Next-Lab workshop for pre-service teachers (LEIC-27022017, see Section 4.2), the detailed responses can be found in Appendix O.

Although 75% of the teachers understood the purpose of the GoModel tool, only a third of them thought their students would (with 58% answered neutral and one even strongly disagreed with the statement that their students would understand the purpose). The participants thought the GoModel tool could be useful for their teaching as well as other teachers, with only 'neutral' and 'agree/strong disagree' answers to the related statements. However, the tool did not work well enough yet: 81% disagreed or strongly disagreed that the tool worked well (about half of the participants chose the option "disagree" for the statement that the tool worked well). The answers in the comment fields and annotations given on the GoModel screenshot in the workshop serve as examples on how this improvement could look like (see Appendix O).

Overall, the pre-service teachers thought that the tool had potential but ought to be improved. Most of them could understand the purpose of the tool and could envisage using it in their own teaching as well as envisaging that other teachers would plan to use it. However, they believed that it would need better help and explanatory materials and that some usability issues needed to be sorted out.

In the PD workshop with students on the GoModel tool (LEIC-03032017, see Section 4.3) we had 16 participants providing 78 PD ideas in total using PDotCapturer. 55 ideas were gathered on the Model Tab and 23 on the Graph Tab. All comments included a textual comment and 5 additionally a drawing of some kind. 34 of the 78 comments (43.59%) were positive (like), 15 comments were neutral (19.23%), and 29 comments (37.18%) were negative (dislike).

As can be seen in the PDot heatmap visualisations of the "emotional responses" on the current design shown in Figure 3, the GoModel tool was perceived mostly positively (especially the Graph tab) but there was also some potential for improvement. This heatmap visualisations are automatically generated for each PDot instruction step by the PDotAnalyser tool (which was developed to support designers in making sense of and analysing data gathered with PDotCapturer, see Heintz (2017) for details) from the meta-data provided with each PD idea. Around the feedback location (derived from the marker position) a semi-transparent circle is drawn, which is coloured based on the smiley selected by the end-user to indicate the emotional response to the current design (green is like, yellow is neutral, red is dislike). Detailed results of this PDotCapturer activity can be found in Appendix P.

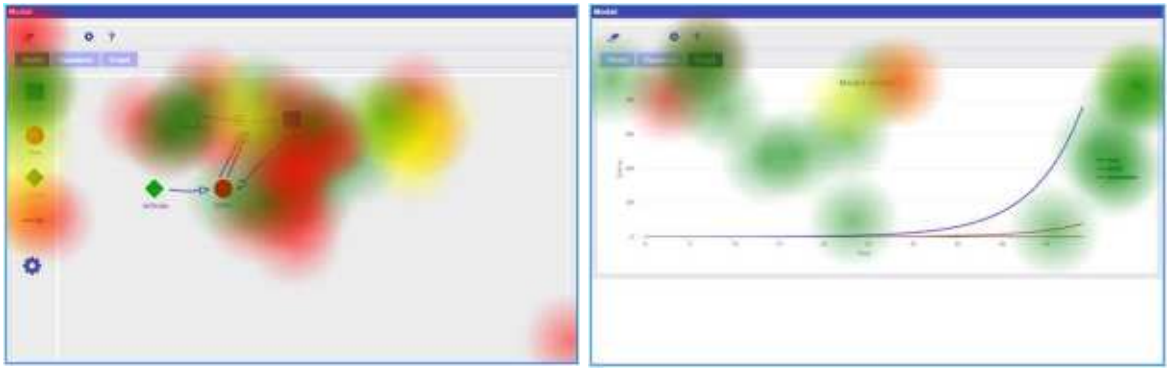

Figure 3. PDot HeatMap on Model tab (left) and Graph tab (right)

From the questionnaire results (see Appendix Q for details) it can be derived that the tutorial video is clear and understandable (only one neutral response (6.25%), 75% agree and 18.75% even strongly agree). About two third (68.75%) of the participants thought that the length of the video is about right, 31.25% thought it is a little too long. This should be addressed by shortening the video in the way described in their comments (e.g. remove repetition, reduce depth of some information). One complaint about the video was that it only explained what the tool did, but not why. However, 62.5% of the participants understood the purpose of GoModel, 25% were not sure and only 12.5% did not. For the statement that GoModel could be useful for the participant's learning it was nearly an equal split between disagree/strongly disagree, neutral, and agree/strongly agree responses (31.25%, 31.25%, and 37.5% respectively). Although the participants mostly thought the tool worked well (81.25% are neutral or agree with the statement that the tool works well), half of them did not think that it was easy to use. They mainly requested additional help and instructions to improve the ease of use.

The frozen version of the GoModel tool used for the PDotCapturer activity only contained a "dummy help", which can at least partly explain the repeated request for more help and support voiced by several participants. But even the GoModel tool available on the Go-Lab sharing platform shows only the message "No help text available, yet" when clicking on the questionmark in the menu. This should be changed to improve the tool. Help text should be provided besides the tutorial video or at least teachers should be enabled to customise help text. Additionally, general usability improvements (e.g. adding undo and redo functionality) should be performed and the visual design of the tool (e.g. icons for variables and visualisation of arrows) should be improved. Detailed descriptions of the issues identified by the participants and suggestions how they could be addressed can be found in Appendix P.

7.1.2 SpeakUp

In the process of performing the analytical study of the Seesaw Lab (LEIC-22062017b, see Section 6.3), also the SpeakUp chat was evaluated, as it was included in the example ILSs for this lab. It is important to notice that the results presented here are focused on SpeakUp being used for one-to-one communication to coordinate collaboration and discuss work and results, not a general assessment of the SpeakUp app.

The SpeakUp chat in the two example ILSs provided by the Seesaw Lab developers (showing either the left or right hand side of the seesaw) allows students to communicate remotely and to discuss their actions and results to solve the tasks given in the example ILS(s) using the Seesaw Lab. Although this worked fine, the user experience and usability of using SpeakUp to chat (between only two persons) could be further improved by

streamlining the interface through stripping it down to the features needed to chat (see Appendix R for details).

The use of SpeakUp for communication and coordination between the students during the end-user evaluations of the Seesaw Lab (LEIC-27062017, see Section 4.8) revealed some issues, which were mostly related to the additional features SpeakUp had over a mere chat app. Although liked by one participant, the rest were confused by the voting feature, as it was unclear to them why and for what they were voting. More importantly, the commenting functionality (which allows users to create a comment thread to a message) resulted in several messages that were either completely missed by the partner or were only found after an extended amount of time and some effort of going through several comment threads.

After observing two groups of participants using the Seesaw Lab, we noticed that managing communication and lab work at the same time was a bit complicated at the moment. To fix that, either both the lab and the chat should be at the same physical level on the screen, or notifications and sounds should be added to new messages and shared objects. In addition, it would be useful for students to be able to know if the partner on the other side is online and active.

Simplifying the SpeakUp app would also improve communication between partners, as it is easy to get lost between its main messages and comments. Users have difficulties in finding new responses or even identifying which ones are theirs. In addition, the option to create polls is causing problems and does not offer many benefits if only two students are using the app to chat with each other. Our conclusion regarding the use of SpeakUp for chatting would therefore be to remove all functionality not needed for chatting to make the app easier to use for this purpose (see Appendix S for the detailed findings).

7.1.3 Viewer App

This section gives an overall assessment of the Viewer app, which is based on the detailed findings from an analytical study (LEIC-03072017, see Section 6.4) presented in Appendix T.

The application seems very straightforward to use, especially for those experienced with the Graasp authoring environment. This viewer can be quite useful so students do not need to go back to previous phases in order to check their work, instead they have it available where the teacher considers it necessary.

At the time of evaluation, the Viewer app was working well for the Concept Map app, but not with other apps it was supposed to work with. This issue has been addressed by the developers in the meantime.

7.1.4 Learning Analytics (LA) apps in General

Besides scaffolding apps, which are used to perform learning related tasks (e.g. using the Hypothesis Scratchpad app to create a hypothesis to be tested in the online lab) the Go-Lab system also contains the learning analytics apps. These apps support learning and awareness by visualising the usage data of the scaffolding apps or the ILS (e.g. for students to reflect on their learning by seeing how much time they have spent in each phase of the ILS using the Reflection Tool and for teachers to see how many of their students are in which phase of the ILS in the Online users visualisation tool).

Twenty-six answer sets were collected for the questionnaire on LA apps for students. Nineteen answer sets were collected for the questionnaire on LA apps for teachers. The detailed responses are presented in Appendix U.

One question on each survey was aimed at gathering insights on the purpose of including LA apps in online lessons. While the answers regarding the purpose of using them for students was nearly equally split between the three options provided (17 for reflection, 16 for awareness, 16 for self-assessment), the results for the purpose for which the teachers used the app was more diverse, with “To keep track of students' progress” being selected most often.

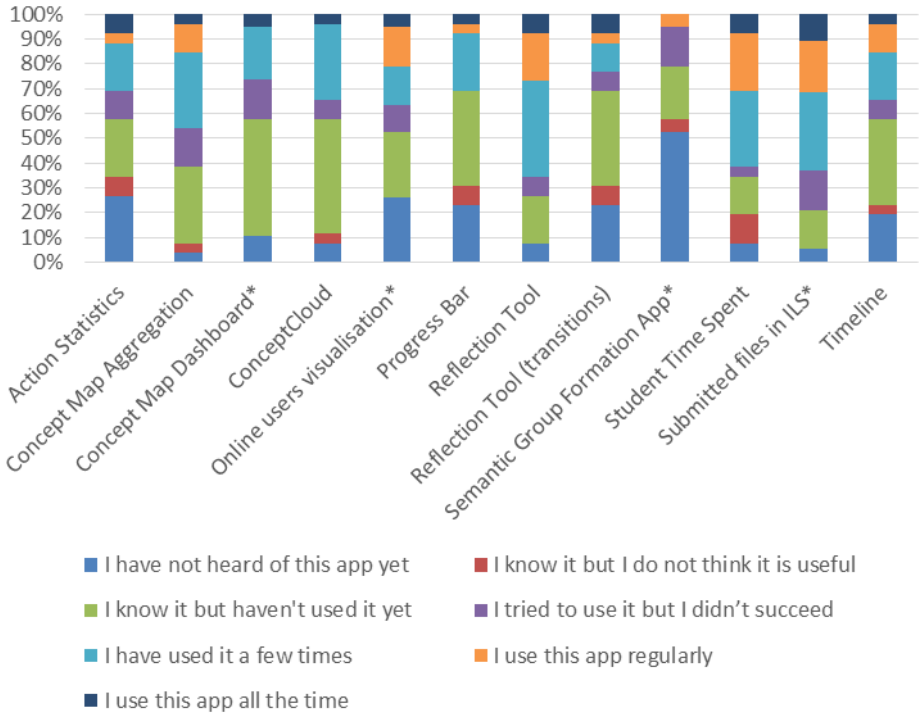

Figure 4. Responses regarding usage of LA apps (26 responses; * = 19 responses only)

From the answers to both questionnaires it can be inferred that the most popular LA apps (see Figure 4) seem to be the Reflection Tool and the Student Time Spent with 17 and 16 teachers (out of 26 participants), respectively, saying that they would use them regularly. With less than half of the participants using this app (12 people) the Concept Map Aggregation comes third on this list. The survey results presented in this report can only give a snapshot from a group of teachers and should thus be supported by the usage data for the different LA apps collected through the Go-Lab sharing platform.

Least known LA apps are the Semantic Group Formation and Action Statistics with at least 6-10 people who have never heard of those apps before the Next-Lab Summer School 2017. Measures could be taken to address this issue of low awareness that these apps exist, for example by picking a “Learning Analytics app of the month” and advertising it on the Go-Lab sharing platform and through social media channels. The advertising message should not only present the app and its functionality, but also include instructions on when and how to apply this app in an ILS.

Apps that people know about but have not used yet include the ConceptCloud, Concept Map Dashboard, Progress Bar and Reflection Tool (transitions). This could again be addressed through the “LA app of the month” strategy described above, not only raising the awareness of the LA apps in general, but also giving inspirations on when, where, and why to use them in ILSs and teaching.

Most of the time (three or fewer teachers failing to do so for each app) the teachers who wanted to use a LA app were successful in doing so. This shows that the application of the LA apps usually worked well. However, a fraction of the teachers could not manage using each of the following apps effectively: Concept Map Dashboard (3/19), Semantic Group Formation (3/19), Submitted Files in ILS (3/19), Concept Map Aggregation (4/26), Online Users Visualization (2/19), ConceptCloud (2/26), Reflection Tool (2/26), Reflection Tool (Transitions) (2/26), Timeline (2/26), and Student Time Spent (1/26). While the fractions are relatively small, the apps should be evaluated in more detail to identify and remove the issues teachers had in using them.

None of the existing LA apps got a high value on the option “I know it but I do not think it is useful” (3/26 [11.5%] being the highest value for only one app: Student Time Spent), for one third of the apps this answer option was not selected at all. Hence, based on the results of this PD activity, there seems no need to remove any of the existing LA apps from the user perspective.

Two questions in each survey aimed to collect some ideas for additional LA apps to be developed for Next-Lab. Regarding the apps designed for students, half of the teachers who answered this question (7 out of 14) did not think that there would be any student needs not yet covered by existing LA apps. For teacher-focused apps, three out of eight of the given answers did not see any uncovered needs. From the remaining answers, one particular topic emerged: assessment. Teachers asked for apps using the LA information to support self-assessment, peer-review, and grading of student work by teachers.

In both questionnaires, other ideas for non-LA apps were suggested (the corresponding frequency was given in brackets):

- Grading tools/apps (8).
- More applications for ICT (4).
- Equation editor app (4).
- Self and Peer-assessment (3).
- Problem Based Learning tools (1).
- Teacher collaboration functionality (1).
- An app combining teachers’ assessment and students’ reflection (1).
- An app allowing students to see the progress of work made by each of their team members (1).
- An app for self-assessment of progress in building knowledge (1).
- An app to let groups of students see the work of other groups (1).
- An app to create cartoons in order to introduce concepts, ideas or just motivate students in a playful way (1).
- “Interest to include APPs that approximate augmented reality, and incorporate QR codes. And start collecting the "big data" with some center location filter, and update some news of great economic, cultural, social, scientific (gravitational waves) importance” (1).

From the second PD activity aimed at issues with specific apps rather than getting an overview about the LA app usage, some general information was also retrieved (see Appendix V to GG for detailed responses). For a third of the 12 existing LA apps (Concept Map Aggregation, Concept Map Dashboard, Reflection Tool, Semantic Group Formation), the teachers actively stated that they would not be useful or difficult for younger students.

To better support this (new) target group in the Next-Lab project, either the LA apps should be reworked or alternative apps for younger students should be developed and offered on the Go-Lab sharing platform.

Although the participants were given a 1.5 hour presentation on LA apps and the detailed information provided for each LA app on the Go-Lab sharing platform was printed out and presented to the teachers at the time of gathering their feedback, for half of the LA apps teachers expressed the need for more information. For these apps (Concept Map Aggregation, Concept Map Dashboard, Reflection Tool (transitions), Semantic Group Formation app, Submitted files in ILS, Timeline) their descriptions on the Go-Lab sharing platform would need to be reworked to better match the information needs of teachers. In general, learning analytics should be made more prominent on the Go-Lab sharing platform to raise the awareness of benefits and opportunities provided by LA apps to enhance educational processes.

For half of the LA apps, at least one rating suggested removing it from the Go-Lab sharing platform. However, this should not result in immediate removal of those apps, but rather be used as an indication for which apps further evaluations are necessary to identify the reasons behind those removal requests and how to address them. Removing the app would obviously be one way, but the underlying issues might also be solved with a clearer description or by providing usage examples for this app.

The following ideas on how to enhance existing tools in general have been gathered:

- Improve user interface for easier navigation and understanding.
- Make sure data are updated in real time.

The following idea for a new tool has been proposed:

- An app that monitors and visualizes the writing activities of the student (in combination with the Action Statistics app).

7.1.5 Action Statistics

The Action Statistics App was rated as more necessary for teachers (mean = 4 from five raters) than for students (mean = 3.25 from four raters). It gives teachers an overview of student activities and provides students with information for self-regulating their learning when they work with other ILSs in the future. Its functionality could be enhanced by tracking student writing and by making the visualization clearer or explaining the presentation of the data in more detail (see Appendix V for details).

7.1.6 Concept Map Aggregation

The Concept Map Aggregation app got a general mean necessity rating of 1.5 from six teachers. A seventh teacher provided a necessity rating for what he called "advanced" students, resulting in a slightly higher necessity rating for this user group (mean = 2 from seven teachers). It was described once on the positive comments as being very useful for teachers. The reasons stated for the low usage of this app were mainly related to poor user experience or low usability, especially for younger students, a confusing interface, for example caused by overlaying nodes and labels (e.g. when using it with many students), and being time consuming. The app could be improved by moving the group of nodes created by one user at the same time or improving its interface (see Appendix W for details).

7.1.7 Concept Map Dashboard

The Concept Map dashboard was not understood by about half of the teachers who commented on the necessity of the app; the remaining four rating the necessity gave it a mean rating of 2.25. It could be improved by making it easier to use, providing more instructions on how to use it, and explaining the app and its purpose better (see Appendix X for details).

7.1.8 ConceptCloud

The necessity of the ConceptCloud app got a mean rating of 2.86 by seven participants with only one negative comment stating that the app was confusing, but no improvement suggestions were given. It was positively perceived (by the teachers) that students liked the app and that it showed all concepts in an overview, which would be a nice addition to the concept maps, allowing the teacher to check if all main concepts appeared or if an intervention would be necessary (see Appendix Y for details).

7.1.9 Online Users Visualisation

The Online Users Visualisation app was rated as 4 by all eight participants who provided a rating on the necessity scale from 1 to 5. It was described as being (very) useful with a nice visualisation and as providing feedback about fellow students, enabling collaboration and communication. One of the improvement suggestions ("visible only for teachers") and the negative comment ("Potential distraction from the learning activity") can already be addressed with the existing functionality, by adding the app to a phase that is only visible to the teacher in the authoring environment. However, as this seems not to be clear for the participants, maybe this functionality needs to be communicated more effectively. The second improvement suggestion for the Online Users Visualisation app is to improve the real time view (see Appendix Z for details).

7.1.10 Progress Bar

Apart from one teacher who wanted the Progress Bar app to be removed from the Go-Lab sharing platform, all seven participants who rated the necessity did so with 4 out of 5. It was already perceived as a (very) useful, easy to use, engaging app that could easily be integrated in ILSs for the self-awareness of students about their learning process, but the app could be improved by adding a text input field where the student can specify the reason for the indicated amount of progress. The two negative comments given were not about the app's functionality, but the conceptual problem that students might not estimate their progress correctly, because of difficulties to do so or their personality leading to under- or overestimation (see Appendix AA for details).

7.1.11 Reflection Tool

The mean necessity rating of the Reflection Tool app from four teachers was 3.25, although apparently not very meaningful for younger students, and it is not clear to the participants why there are two reflection tools instead of only one. The app was perceived as practical for teachers and for students to raise their awareness of the different demands of different ILS phases to support self-regulation in the future, to give feedback to the teacher, and to estimate the time spent in every phase (see Appendix BB for details).

7.1.12 Reflection Tool (Transitions)

The necessity of the Reflection Tool (transitions) app was perceived higher for teachers (mean = 2.83) than for students (mean = 2.63) by the eight participants giving a necessity rating. The Reflection Tool (transitions) app can support students by giving them a reference

of the teacher's expectations as well as helping teachers create better ILSs by helping them understand students' behaviour (see Appendix CC for details).

7.1.13 Semantic Group Formation

Three of the ten teachers rating the necessity of the Semantic Group Formation App did not understand this app. Two voted for removing this app from the Go-Lab sharing platform with one giving the explanation that it would not be needed, given that teachers normally know their students well. The remaining five participants, who specified a necessity rating between 1 and 5, rated the Semantic Group Formation App with a mean of 2.8. While some teachers find the app cool and an excellent idea, others were not sure where the data for this app would come from, saw low applicability, especially for younger students, and wanted to get rid of it (see Appendix DD for details).

7.1.14 Student Time Spent

The mean necessity rating of the Student Time Spent app for teachers by the nine participants who rated it was very high with 4.78, with one teacher even giving it a "6 not just 5" (nevertheless counted as a rating of 5 to calculate the mean rating value). One teacher wanted to remove the app from the Go-Lab sharing platform "in the name of students" but otherwise its necessity for students was rated with a mean of 3.86. The Student Time Spent app could be enhanced by improving the connection problem and making it an overlay in the ILS, so that the time spent could be checked in real time constantly. The only negative comment was not about the functionality of the app, but the conceptual issue that students could focus too much on time spent instead of learning the content. For teachers the app would be useful because it could help them to control the students, whereas students may use it to become more aware of their work organization (see Appendix EE for details).

7.1.15 Submitted Files in ILS

One participant did not understand the Submitted Files in ILS app, but other than that it was the best rated LA app with a mean necessity rating of 4.83 calculated from the individual scores of six participants rating it. The app could be improved through an interface that is more usable. One issue with the app was that it mixed the files if there were more than one file drop in an ILS. It was perceived positively that the app allows people to use all the possible resources and was rated very good for monitoring and evaluating the work of students (see Appendix FF for details).

7.1.16 Timeline

One out of ten teachers rating the necessity of the Timeline app wanted it to be removed from the Go-Lab sharing platform, the other nine rated it with a mean of 3.44 for teachers and only slightly lower for students (mean = 3.33). To improve the app it should check the ILS in real time and the interface should become more usable. Negative comments were given regarding the functionality (the feature "showing data from day", which allows the user to switch between the presentation of timelines of different dates, was pointed out as not always working) and the reasoning of the app (no clear value for the students). On the other hand, the app was perceived as useful for students (e.g. for homework) and especially for teachers to get insights into how students work and to evaluate existing and design future ILSs (see Appendix GG for details).

7.2 Seesaw Lab

Analytical study:

The following paragraphs give an overall assessment of the Seesaw Lab based on the results of an analytical study (LEIC-22062017b, see Section 6.3), details are given in Appendix HH.

The Seesaw Lab is a useful lab for encouraging collaboration between students without having to be in the same physical location. Communication is facilitated by trying to achieve the same objective. While setting up the Seesaw Lab in an ILS is a little bit more complex than the procedure for other online labs, based on the remote nature of the Seesaw Lab requiring two ILSs to work, the instructions should be clear enough to follow for teachers with at least some experience with the Go-Lab authoring facilities. However, setting up ILSs using the Seesaw Lab could be further supported by correcting some odd phrases in the instructions.

The Seesaw Lab offers an innovative way of exploring balance and weight, with only seeing and being able to control one side of the seesaw. The remote interaction between two people mostly worked fine, some of the issues described could only be caused by intentionally forcing them to happen. But given the explorative nature of students, who might be inclined to test out the limits of the lab, they should still be fixed to make the lab more robust for its use in teaching. With the chat being the integral mode of communication between the students, having it in a separate app, detached from the Seesaw Lab, causes some issues.

The current Seesaw Lab is already a very good first attempt as a remote collaboration lab. Most of the interactions work well and is engaging. However, some issues have been identified, which should be addressed to improve the overall usability and user experience.

User-based evaluation:

The following paragraphs give an overall assessment of the Seesaw Lab based on the results of the two end-user evaluations of the Seesaw Lab (LEIC-27062017, see Section 4.8), details can be found in Appendix II.

The overall reaction of the participants towards the Seesaw Lab was positive and apart from some miscommunication problems, they enjoyed the experience of working collaboratively on a virtual environment. The participants were engaged with the objective of solving all questions given in the ILS, and they ended up gaining some new knowledge regarding equilibrium or balance. However, the user-based evaluation also revealed some issues and possible improvement potential for all parts of the example ILS that was used by students to remotely work on solving the challenges presented.

The main issue with the Seesaw Lab was that the students could not see what was going on the other side of the seesaw (e.g. how many objects were put there). Therefore, with the participants being unable to communicate immediately while using the lab, sometimes they ended up working on (or answering) different questions because they would fail to tell how many objects were actually on the seesaw. Users suggested that it would be good to see all objects on the seesaw after balancing it as this would facilitate their understanding of the topic and help formulating their answers.

7.3 Inquiry learning Spaces (ILSs)

During the twilight session with teacher trainers (LEIC-13062017, see Section 4.6), one of the two participants commented on the general ILS design. According to the teacher, the tabs should have arrows (or other indicators or restrictions) to make it clear for the students

that they are supposed to follow the process tab-by-tab, otherwise there is the danger of them jumping ahead to experimenting straight away.

During the end-user evaluations of the Seesaw Lab (LEIC-27062017, see Section 4.8) two major issues regarding the "Example ILSs" (http://www.golabz.eu/spaces/how-does-seesaw-work-version and http://www.golabz.eu/spaces/how-does-seesaw-work-version-b), provided by the Seesaw Lab developers to experience the Seesaw Lab, were discovered:

- First, in the current layout SpeakUp was put above the Seesaw Lab in the two ILSs; the constant scrolling was perceived as annoying and the separation led to missing chat messages and seesaw balancing results. Our recommendation based on the user evaluation would therefore be to integrate SpeakUp into the Seesaw Lab or if that is not possible at least to put both next to each other instead on top of each other.
- Second, the phrasing of the questions in the example ILSs was problematic (e.g. "Can you make the seesaw balance using 3 objects?"). The participants were confused regarding the number of objects; they mostly thought that the number in the question would refer to the number of objects on their side of the seesaw. We would thus recommend rephrasing the questions to something like "*Can your team make the seesaw balance using only 1 object?*" A general issue that occurred with having several questions was that both partner teams would become out-of-sync at some point with one partner working on question 3 while the other partner was already working on question 4. Collaborative answering of questions (i.e. a text box that accepts and presents input from both partners at the same time) could be used to prevent this issue.

The detailed findings resulting in this overall assessment is in Appendix JJ.

7.4 Infrastructure Components

7.4.1 Keywords

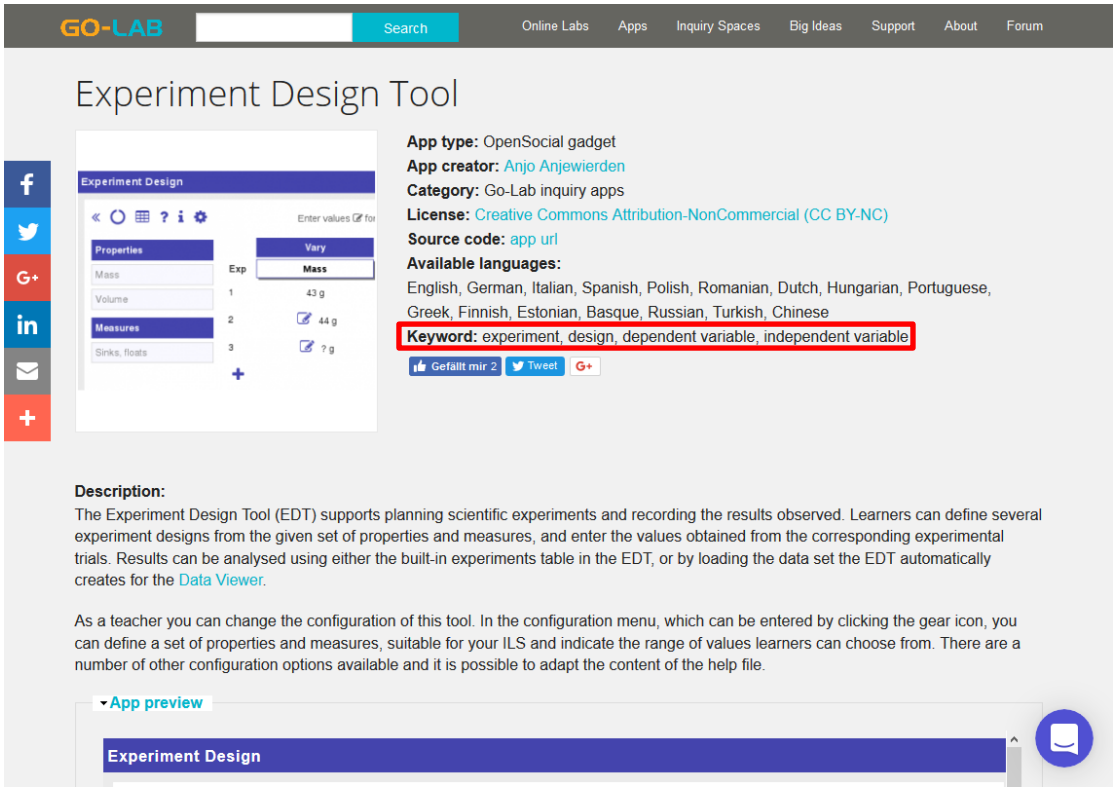

Figure 5. Keywords on the Go-Lab sharing platform, in this example screenshot used to further describe the Experiment Design Tool (red border added for highlighting)

The Next-Lab Core Group and PD Teacher participants responding to the keywords task (LEIC-00032017, see Section 5.1) agreed that the keywords provided should always be displayed on the Go-Lab sharing platform (on average 6.6 on a 1 to 8 points scale, see Figure 5 for an example of the current presentation of keywords on the Go-Lab sharing platform). They perceived keywords as useful for labs (mean = 6.25), apps (mean = 6.38), and ILSs (mean = 6.5). Although they agreed that keywords should be usable for searching (mean = 6.25) only about half of them agreed that only entities of the same type (e.g. apps, las, or ILSs) should be returned through a keyword search on the Go-Lab sharing platform, while the other half disagreed (mean = 4.75). An undecided split into two halves was also the case regarding the question if keywords should be selected from a predefined list or if there should be free text input (mean = 4.5). Overall, the respondents thought that there could be more pressing issues to fix in the Go-Lab system than keywords. Detailed responses to this activity are in Appendix KK.

To collect more responses the keywords questionnaire was also used at the Ambassadors Workshop in Brussels (LEIC-06052017b, see Section 4.5). The key emerging recommendations are:

- Any keywords entered should be visible on the Go-Lab sharing platform.
- Keywords could be useful for apps, labs and ILSs
- Keywords should be searchable

- When doing a search (on keywords or otherwise) many of the teachers would like to be able to restrict the scope to just labs, just ILSs or just apps. But some asked for the option to search all entities to be kept. It may be worth considering providing three tick boxes beside search so that the user can specify whether the scope is to include labs, apps and ILSs.
- We had a question about when a person provides a keyword, they should be able to type free-form text or have to select from a standard vocabulary. This question received very mixed responses, and it needs further thought. The responses we have received to this question are not clear or consistent enough to provide guidance.

The combined results of the 8 CGT teachers and 11 ambassadors are presented in Appendix LL.

7.4.2 Peer Assessment

The main findings and recommendations on peer assessment, which were derived from the Ambassadors workshop in Brussels (LEIC-06052017b, see Section 4.5 for details and Appendix MM for the results), are presented as follows:

- Lesson time is very limited for some teachers, so they need quick processes
- Automatic random matching of assessors was **strongly** favoured
- Everything should be available in national languages
- The time needed to train pupils to do this could be perceived as a critical barrier
- Peer Assessment may be most appropriate for older school students, and inappropriate in primary schools
- It seems a small proportion of teachers may already be keen on peer assessment; a small proportion disliked it and wanted to provide feedback themselves; a large proportion were not originally convinced but would be open to the possibility that it might be useful.

7.4.3 Suitability of Apps for Younger Students

The raters participating in the analytical study on suitability of the Next-Lab apps for primary school students (LEIC-30052017, see Section 6.2) stated that 23 out of the 42 apps available on the Go-Lab sharing platform would be suitable for young children from the age of eight upwards (being rated as suitable for this age range by at least one rater):

- Action Statistics
- Calculator
- Concept Mapper
- ConceptCloud
- Experiment Design Tool
- File Drop
- Hypothesis Scratchpad
- Input Box
- Observation Tool
- Online users visualisation
- Padlet

- Progress Bar
- Quest
- Question Scratchpad
- Quiz tool
- Reflection Tool
- Reflection Tool (transitions)
- Report tool
- Shared Wiki
- SpeakUp
- Table tool
- Teacher Feedback
- Wiki App

Another eight apps could be used for children from the age of ten upwards:

- Chempy
- Conclusion Tool
- Data Viewer
- Equation Editor
- Function Plotter
- GoModel
- Mindmeister Widget
- Periodic Table

Only four apps were categorised as suitable only for students over twelve years old and thus outside the primary student range of 11 years and younger:

- Experimental Error Calculator
- Geogebra
- SSH Webconsole FORGEBox widget
- Sysquake

The remaining seven apps was classified as aimed at teachers, not at students:

- Automatic Generator of User Interfaces for Smart Labs
- Concept Map Aggregation
- Concept Map Dashboard
- Semantic Group Formation App
- Student time spent
- Submitted files in ILS
- Timeline

These results (see Appendix NN for full responses) indicate that most of the existing apps are not only suitable for secondary, but also for primary school students.

Although some comments were made during this assessment regarding the possible need to train students before they could use some apps properly, most of the apps would not require extensive explanation and could be quite intuitive to learn to use.

Of the 7 Next-Lab Core Group and PD Teachers, who were given the task to rate the existing apps regarding their suitability for younger (primary school) students (LEIC-23062017, see Section 5.2 for details), four completed the task and returned their ratings. One participant rated the full set of 42 apps and three rated the requested 21 apps (one rated the top half of the list, the other two the bottom half, as asked for in their task description). Thus, each app was rated by at least two teachers (see Appendix OO for details on the responses).

About a fourth (10 out of 42) of the apps on the Go-Lab sharing platform were rated as suitable for primary school students by all participants, who rated them:

- Calculator
- Data Viewer
- File Drop
- Hypothesis Scratchpad
- Input Box
- Observation Tool
- Padlet
- Quest
- Quiz tool
- Teacher Feedback

This shows that Next-Lab already offers quite a good number of apps for the target group of primary school students, but there is still some room for improvement. As the teacher sample size of this study was rather small, it should be repeated with more teachers. Nonetheless, it can already be used as a first indication and to inform future studies on the suitability of the Go-Lab apps for younger students.

Based on these lists, one can identify which functionalities in the existing apps are unsuitable for younger students and which suitable functionalities should have been provided. The insights thus gained can inform the redesign of the existing apps and the development of new ones (e.g. if from a pedagogical point of view the functionality to explore experimental errors would be needed for primary school students, a new app would have to be developed for them, as the Experimental Error Calculator currently available is not suitable).

For the apps that the teachers did not agree if they would be suitable for younger students, they could directly be evaluated with primary school students, thereby identifying which of them could already be desirable and deployable for them and how the other less desirable apps could be re-designed.

7.4.4 Chat

In the Ambassadors workshop in Brussels (LEIC-06052017b, see Section 4.5) feedback on the chat functionalities was collected using a facilitated discussion where some specific questions were posed and teachers had the opportunity to express their opinions and contrast them with those of their peers. Participants thought that it would be useful to introduce chat facilities into some of the Next-Lab artefacts in general as long as they could

select to enable or disable it when adding the app/lab to an ILS. Teachers also suggested that it would be convenient if they could read the messages sent between students as long as it would be clear to students that their teacher could do so. Also, most teachers agreed that it would be better to have a chat inside a specific artefact rather than a general chat facility as it would be too open to abuse, and some ideas were proposed on how to do this. In general, the concept of adding new chat functionalities in some Next-Lab artefacts was very well-received and teachers were keen to try their benefits in classroom. The questions prepared to facilitate the start of the discussion are presented in Appendix PP.

Five participants responded to the chat questionnaire (LEIC-07072017, see Section 5.3). Most of them had much experience with the Go-Lab system, in creating an ILS as well as using an ILS in the classroom. All example activities a chat could support were rated as being important or even very important (besides one neutral response for 'Allow students to ask questions to fellow students'). A list of other students and the option to reply to individual messages were rated as features worth having, the other features listed were perceived as not needed. All integration options presented in the questionnaire (global chat, phase-wide chat, chat app, chat as part of lab or app) should be made available. Although one teacher wanted a chat for the whole class and another one thought it would depend on the aim, the majority of teachers preferred different chats for smaller groups of students. Detailed responses to the chat questionnaire are in Appendix QQ.

7.4.5 Scenario Integration

Data on the integration of the scenarios in the Go-Lab sharing platform were collected in a twilight session with teacher trainers at the University of Leicester (LEIC-13062017, see Section 4.6 for details). As there were two researchers present for two participants, a formal usability test, which is typically implemented on a one-to-one basis, was conducted; verbal comments (using the thinking aloud protocol) and observations were collected in addition to the feedback gathered using PDotCapturer:

- General remark: teachers are busy people, the description/information on the scenarios is great, but too much text makes it time consuming to read through;
    - Teachers want quick instructions on how to use it with their students
    - Information should be hidden behind [+]-buttons or links
    - Break the text up or include bullet points to improve readability
- Scenarios are not too difficult to find on the Go-Lab sharing platform but they could possibly be more visible if the button is either located on a different place or has a different colour
- Pictures are engaging and can immediately draw attention
- Descriptions about performance/features/usability are more useful than high level descriptions
- It would be nice to include keywords or ratings for sortability
- The scenarios are appreciated, but their presentations need to be improved

Using PDotCapturer, feedback on different aspects of the scenario integration and presentation in the Go-Lab system was gathered:

- Scenario Integration in the Go-Lab sharing platform:
    - The colour of the "Check out the scenarios" button should be changed so that it stands out more and is no longer merging in with the rest of the page (colours). If possible the text on the page should be shortened.

- Scenarios overview page on the Go-Lab sharing platform:
    - The pictures for the scenarios are perceived as engaging but there is a danger that the text are drawn to them, skipping the text above. A proposed solution is to put the pictures first and then the text. The text on the page should be shortened and structured better using bullet points instead of a list that is presented in running text.
- Basic scenario (for a blank ILS containing only the default phases):
    - The picture and introduction were perceived as good and clear. However, the text could be structured better by using bullet points instead of running text and move the links to additional information further up and by presenting less information, with additional text available through links. An additional improvement suggestion is to convert the “Further reading” references into hyperlinks, which would make it easier for the teachers to access the texts.
- Find the mistake scenario:
    - Again, the participants think there is too much, too detailed text as one big text block on this page and suggest to either hide it or split it up and use bullet points to structure it further. Two spelling errors (“apporach" instead of approach and “misconcpetions” instead of misconceptions) were pointed out that should be corrected.
- Learning by Critiquing scenario:
    - The scenario idea was perceived positively, but the presentation should be improved by breaking down the text.
- Structured controversy scenario:
    - No feedback was given in PDotCapturer on the structured controversy scenario.
- Six thinking hats scenario:
    - The level of information in the description of the Six thinking hats scenario was perceived as useful but too detailed for teachers.
- Jigsaw approach scenario:
    - The description of this scenario was perceived very well, because it gave practical descriptions on how this scenario could be applied, as was the scenario idea itself. Still the structure of the text could be improved, as on other scenario description pages as well.
- Scenario integration in Graasp:
    - Regarding the scenario integration in Graasp the participants would like to see examples for each scenario, before creating their own ILSs.

From the two participants, 27 comments were gathered in total, all of which included a textual comment and seven of which included a drawing of some kind. Six of the 27 comments (22.23%) were positive (like), 6 comments were neutral (22.23%), and 15 comments (55.56%) were negative (dislike).

In general, the participants liked the scenarios and their presentation. However, they thought that there is too much text on the pages, which should be shortened and structured better. Detailed information should be made available through links, revealing more text for interested readers. Example ILSs should be presented for each scenario. The detailed results of this activity can be found in Appendix RR.

Using PDotCapturer, feedback on different aspects of the scenario integration and presentation in the Go-Lab system was also gathered at the Next-Lab Summer School 2017 (LEIC-11072017d, see Section 4.9). Here is a summary of the findings, the detailed results can be found in Appendix SS:

- Scenario Integration in the Go-Lab sharing platform:
    - The integration of the scenarios in the Go-Lab sharing platform was perceived mostly positive. Only one of the 5 positive textual comments on this screenshot was not about the scenarios, but filter options, the others highlighted positive aspects of the textual descriptions on the page and the link to the scenario overview page. For the large number of positive markers, no textual description or explicit explanation was given why or what was perceived well. Nonetheless, the sheer number of positive markers (48, especially when compared with the low number of four neutral and three negative ones) indicated that this page was rated as good by the participants.
    - The “Check out the scenarios” button was perceived neutral by the participants. This indicated that the current way of presenting access to the scenarios worked, but a better solution could be found (e.g. giving them their own entry in the menu on the top of the page, see negative comment related to this below). The other two neutral comments on this screenshot were not related to the scenarios, but the filter options.
    - There were two negative comments related to the presentation of scenarios in the Go-Lab sharing platform. One of them suggested to put the scenarios in the menu on the top of the page instead of integrating them in Inquiry Spaces, the other one complained that there was too much text at once in the description of Inquiry Spaces. To address these comments, scenarios should get their own menu entry and the text should be split up in smaller paragraphs.
- Scenarios overview page on the Go-Lab sharing platform:
    - The integration of the scenarios in the Go-Lab sharing platform was perceived mostly positive. The six positive comments with a textual description highlighted three areas of scenario integration: having scenarios in general, description of scenarios and especially useful scenarios. Having the scenarios in general and their descriptions were perceived as interesting and useful and as providing examples on how to apply inquiry based learning. The scenarios that were highlighted as especially useful were “Find the mistake” (2x), “Six thinking hats”, “Jigsaw approach”, and “Structured controversy”. Besides the “Basic scenario”, which starts with an empty ILS containing only the default inquiry phases, “Learning by Critiquing” was the only scenario not specifically mentioned.
    - The two neutral markers without textual description were placed next to the scenario “Learning by Critiquing” and on the “Jigsaw approach” scenario. Likewise the neutral comment with a textual description was also put on the “Jigsaw approach”, critiquing the implementation of the Jigsaw approach in the Go-Lab sharing platform.
    - Although there was no comment explicitly marked as negative, from the feedback on the overview page for the scenarios it can be derived that all of

them were perceived as positive, with some underlying or explicit criticism on the “Learning by Critiquing” and “Jigsaw approach” scenarios.

- Basic scenario (for a blank ILS containing only the default phases):
  - The description of the Basic scenario in the Go-Lab sharing platform was perceived mostly positive. Based on the three textual descriptions given as positive comments, the Basic scenario was perceived well because it is comfortable to use, structured, and useful, as it allowed users to create any kind of ILS while following the scientific method of inquiry.
  - The neutral marker without textual description was on a blank part of the page underneath the general information, thus it seemed to indicate a general neutral attitude towards the Basic scenario. The second neutral comment was rather positive but requested a simpler version for primary school students.
- Find the mistake scenario:
  - The description of the “Find the mistake” scenario in the Go-Lab sharing platform was perceived only positively. The “Find the mistake” scenario itself was perceived as very good, easy to follow and very useful, because learning is identifying misconceptions, it helps to work on critical thinking skills in a structured way and gets students to think, involving higher order skills at the same time. Only positive comments were given on this scenario, no neutral or negative ones.
- Learning by Critiquing scenario:
  - The description of the “Learning by Critiquing” scenario in the Go-Lab sharing platform was perceived mostly positive. All comments were positive (the emotion “Like” was selected), although some critique and improvement suggestions were provided. One neutral comment was given because the participant remarked that it would be necessary to try out the scenario in classroom. The “Learning by Critiquing” scenario was perceived useful, for example, because being critical is a necessary skill, but difficult to implement. One improvement suggestion to make the scenario easier to apply would be to break it into smaller parts and provide additional guidance by an experienced user.
- Structured controversy scenario:
  - The description of the “Structured controversy” scenario in the Go-Lab sharing platform was perceived half positive half neutral. While one of the participants thought this was the most useful scenario of all scenarios, another teacher commented that structured controversy could be integrated in the other scenarios.
- Six thinking hats scenario:
  - The description of the “Six thinking hats” scenario in the Go-Lab sharing platform was perceived only positively. The “Six thinking hats” scenario itself was perceived as useful, especially in the discussion phase and for controversial topics as was the description of the scenario, which was easy to understand. No neutral or negative comments were specified.
- Jigsaw approach scenario:
  - The description of the “Jigsaw approach” scenario in the Go-Lab sharing platform was perceived mostly positive. The “Jigsaw approach” scenario

itself was mostly perceived positively, as it was great for teamwork, projects, and diverse students and the participants enjoyed it. However, one of the positive, the one neutral, and the one negative comment given indicated that the presentation and description of the scenario on the Go-Lab sharing platform needed to be improved, as it was currently not clear when and in which phases students should work in home groups and in expert groups.

- Scenario integration in Graasp:
    - The integration of the scenarios in the Graasp authoring environment was perceived half positively and half neutral. Although indicated as being a positive comment, from the content it can be derived that the participant would have liked to have added functionality to help organizing all Next-Lab-related activities and resources.

From the 24 participants, 136 comments were gathered in total, 88 of which only indicated like, neutral or dislike at a certain position and 48 of which included a textual comment. Fifteen of the 136 comments included a drawing of some kind. 114 of the 136 comments (84%) were positive (like), 16 comments were neutral (12%), and 6 comments (4%) were negative (dislike).

Overall the presentation and integration of scenarios in the Go-Lab ecosystem was perceived well. During the PDotCapturer activity some teachers proposed a menu entry on the Go-Lab sharing platform next to apps, labs and spaces. On the other hand, during the discussion after the tool usage, some teachers said it would be good that the scenarios could be more conspicuous. Teachers should first learn how to create an ILS with the basic scenario (from scratch) and then add the other scenarios. The way scenarios were currently presented on the Go-Lab sharing platform and integrated in the Graasp authoring environment, teachers discovered the “basic scenario” first and only later discovered and learned about the “advanced” option to start with pre-defined scenario elements and content.

Although the explanations on the website were perceived as good, one teacher commented verbally during the PDotCapturer activity that real workshops were needed to get started. Once the teachers learned about how to create an ILS in a real session, they could then use the information on the websites to create further ILSs. Additionally, some criticism on the “Learning by Critiquing” and “Jigsaw approach” scenarios was expressed by the participants. These two scenarios should therefore be reworked to improve their usefulness for teachers.

The discussion following the PDotCapturer activity also elicited some more improvement suggestions:

- For primary school students, simpler versions of the scenarios could be offered, e.g. only 3 hats instead of 6.
- There should be a search and filter option on the Go-Lab sharing platform to find ILSs based on the scenario used to create them.
- There should be at least one “best practice” ILS created by pedagogical experts for each of the scenarios, which is linked to on the scenario page, so that teachers can see examples of how the scenarios are applied.

In teaching practice, teachers would sometimes start with a scenario and sometimes start with a blank ILS, but the participants of the Next-Lab Summer School reported that it was a good experience to start with a scenario for the ILS they created. To make more teachers

aware of this possibility and let them experience starting their ILS with a scenario rather than from scratch, this activity could be conducted in more teacher training events. In parallel social media and other communication channels could be used to promote scenario usages, especially to teachers who were already experienced in creating ILSs from scratch.

Additional data on the scenario integration were collected using PDotCapturer in a Next-Lab core group and PD teachers' task (LEIC-04082017, see Section 5.4). From the 2 participants replying to the task, 34 comments were gathered in total, 3 of which only indicated like, neutral or dislike at a certain position and 31 of which included a textual comment. Five of the 34 comments included a drawing of some kind. Twenty of the 34 comments (58.82%) were positive (like), 10 comments were neutral (29.41%), and 4 comments (11.76%) were negative (dislike). Here is a summary of the findings, the detailed results can be found in Appendix TT:

- Scenario Integration in the Go-Lab sharing platform:
    - The "Check out the scenarios" button was perceived positively and as quite visible. Another positive comment stated that it was perfect that teachers could adapt scenarios that are already done in an ILS.
    - The information presentation in long paragraphs was perceived negatively, bullet point lists were proposed instead. Another improvement suggestion was to not separate ILS creation from scratch or by cloning an existing one from the option to start one's ILS based on a scenario.
    - The neutral comment on this page was unrelated to the scenario integration and stated that it should be explained more clearly what it meant to "publish" an ILS (e.g. other teachers can use it).
- Scenarios overview page on the Go-Lab sharing platform:
    - Besides a positive comment on the icons used and some general remarks on the different scenarios there were mainly two negative comments with improvement suggestions on this screen. The first one criticized the unspecific description of what scenarios were and proposed an alternative one ("scenarios are differents structures proposed for ILS that deal or emphasize differents aspects of inquiry..."), the other one suggested having an entry for "Scenarios" in the main menu on the top of the page.
- Basic scenario (for a blank ILS containing only the default phases):
    - The familiar structure of the page (compared to the lab and ILS presentation pages) was perceived positively. However, the paragraphs of text were perceived as too long and complicated. The links to the different phases were reported as being confusing and not working. The further reading references were liked, but it was criticized that they were not directly linking to the articles.
- Find the mistake scenario:
    - While one participant commented that it would be interesting to apply this scenario, the other one repeated his feedback on the previous page (see Basic scenario one above) that text, links, and references needed to be improved.
- Learning by Critiquing scenario:

    - Again, the feedback on the previous two scenario description pages (“Basic scenario” and “Find the mistake scenario”) was repeated, with an emphasis on making the description clearer.
- Structured controversy scenario:
    - Again, the feedback on the previous scenario description pages was repeated.
- Six thinking hats scenario:
    - While one participant commented positively that the icon was an adequate visual representation, the other one repeated the critique already given for the previous detailed scenario pages, this time with an emphasis on the scenario description, which was perceived as very complex and therefore in need of more details to enable teachers, who did not already know the scenario, to apply it.
- Jigsaw approach scenario:
    - While one participate rated this scenario as interesting but complex the other one repeated the critique from earlier scenario details pages and emphasized that the description needed to be improved, because although he or she knew this scenario, he or she would not know how to apply it after reading this description.
- Scenario integration in Graasp:
    - One participant rated the Intercom integration positively, the other one the fact that there seemed to be no big changes in Graasp when using the different scenarios.

7.4.6 ILS Submission and Publishing

Analytical study:

The following text describes an overall assessment of the ILS submission and publishing process from an analytical study of the ILS publishing process (LEIC-22052017, see Section 6.1). Detailed findings are in Appendix UU.

The publishing process itself did not seem to be overly complicated and most of the steps involved were self-explanatory. However, the sequence of interactions could be altered to better reflect the user expectations (i.e. specify information first and only afterwards make the ILS together with the meta data available on the Go-Lab sharing platform).

When initiating the publishing process, a popup with a summary on the consequences of the user’s actions was displayed. Further help and support was provided on the Go-Lab sharing platform (e.g. tutorial videos on publishing). This was helpful, but some of the information there was outdated (e.g. the video does not describe the review process) and the help and support resources should be directly accessible from where the publishing process could be initiated (to make it easier for the teachers to find them and to get to know what the ‘Submit inquiry space’ button does, before/without actually clicking on it).

The separation of the forms into several tabs could lead to an interface that was structured and not cluttered (e.g. by having everything on one page), thus facilitating readability. It also helped the user to focus on specific aspects of their ILS when providing information. Minor improvements could be done regarding specific phrases or formatting styles used throughout the forms. A major possible improvement for the form would be the addition of automatic, system-based error checking. For example, in the evaluation session the

evaluators were able to publish (submit for review) an empty (content-wise; there were the default phases but nothing else altered or added) ILS. The system should be able to detect this and other possible problems in the ILS and at least provide a meaningful warning message to the teacher, if possible with an option to fix it automatically and where this is not possible with a detailed explanation on how to fix the problems or even prevent publishing completely, until they are fixed.

User-based evaluation:

The participants of the twilight session with teacher trainers (LEIC-13062017, see Section 4.6) found the interface on the Graasp side mostly clear, but perceived the overall process as not clear. Publishing should only happen after specifying all the information. Details and some concrete improvement suggestions for the Go-Lab sharing platform side of the publishing process can be found in Appendix VV.

Most teachers at the Next-Lab Summer School 2017 (75-90%) had published an ILS before they attended the workshop there (LEIC-11072017c, see Section 4.9) and although there were some suggestions for improvements, nobody claimed to having had any problems while doing so. The publishing process seemed therefore well understood and properly used by the participants (see Appendix WW for details).

From the comments collected on the booklets, we could infer the following points:

- Participants have different needs and therefore dissimilar ideas of how things should work or look like. For instance:
    - Around half of teachers preferred the new text editor as it appeared less cluttered and easier to use. However, the other half would benefit from having more editing options (e.g. subscript and superscript) thus liked the old version better.
    - Some participants thought that the page about the Big Ideas of Science had improved in the new publishing process (by deleting the long descriptions) but others thought the context was missing and that more information should be provided.

These two issues could be resolved by adding the option to expand these segments according to each teacher's necessities. For example, by displaying a default basic text editor for all users but allowing them to change it to a more advanced one if necessary; or, by expanding the definitions of the big ideas of science if required (i.e. using the + symbol).

- There were a few topics that were not very clear for the teachers and should be explained in better detail on future events or on the corresponding webpage:
    - Peer to peer sync.
    - Licenses.
    - 'Work Offline' option.
- Some suggestions emerged from their past experiences of publishing ILSs:
    - Save configurations for future use
    - Especially when they published the same ILS with a few alterations (e.g. language, content), teachers wanted to copy the same details into the forms to save some time and effort.
- The change that most people disliked was the selection of Subject Domains of the ILSs. At least a third of the participants identified the old interface as better suited for the publishing process compared to the new one. The main reason for this

opinion was that the new style took up too much space and did not look as user friendly as the one in the old system.

7.4.7 Registration Process for Go-Lab Community and Next-Lab Events

A survey containing two main sections (described in more detail below) was administered to the participants of the Ambassadors workshop in Brussels (LEIC-06052017a, see Section 4.5) in order to assess some of the key points regarding the registration process and respective forms.

The first section of the questionnaire included general questions about online privacy attitudes.

A summary of the results is shown in Figure 6, and the full questions are as follows:

1. I am generally quite concerned about privacy of my personal information when I use the Internet.
2. I normally read a website's privacy policy in full before I register.
3. I will happily enter my personal information into a website that I trust.
4. I trust Graasp more than other websites.

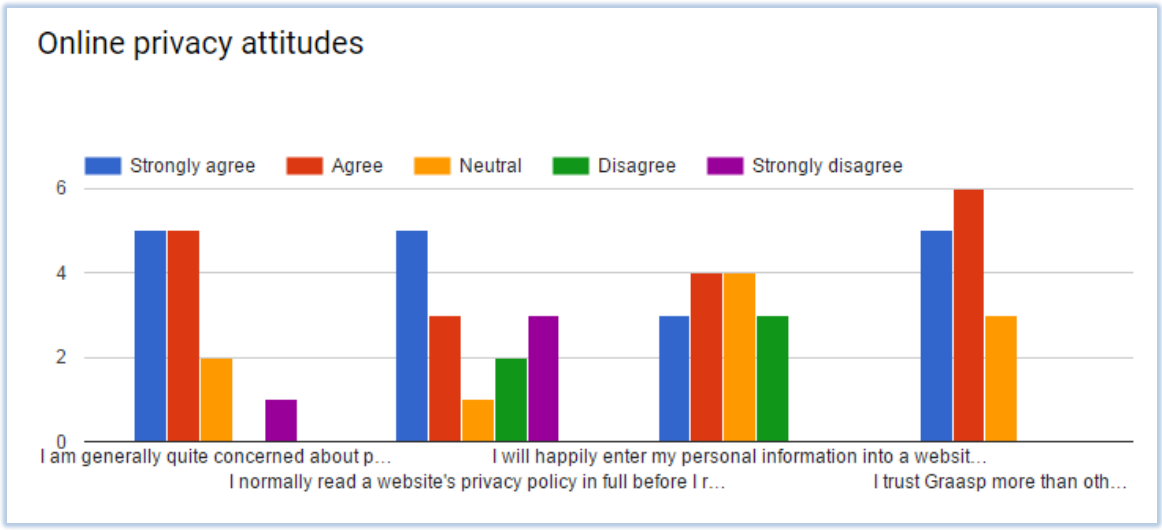

Figure 6. Responses regarding general online privacy attitudes

For the first option, there were a total of 10 positive answers (5 strongly agreed, 5 agreed), 2 neutral and only 1 negative. It could be concluded that most people taking the survey were quite concerned about their privacy on the Internet and the data they submitted to any website.

The second question had a larger variety of responses. In total 8 positive, 5 negative and 1 neutral, which indicated that although half of the users read a website's privacy policy in full, still a quite high number of them did not read the terms and conditions before registering. On the other hand, the vast majority of ambassadors would accept most clauses included in the Signup forms.

For the third question, people appeared indecisive about the extent of personal information they would provide to a trusted website. Nobody strongly disagreed to deliver such data, but only about half of them would be willing to do so if it was necessary.

The final question of the first section was aimed to measure the level of confidence that users had regarding Graasp. Eleven out of 14 participants would trust the Go-Lab sharing platform more than other websites.

The second section of the questionnaire included more specific questions about the Graasp signup processes.

A summary of the results is shown in Figure 7 and the full questions are as follows:

1. I think all questions are clear and easy to complete.
2. The signup questions would discourage me from using the system.
3. The signup questions could discourage other teachers from using the system.
4. The forms are concise.
5. The questions seem intrusive.
6. I understand how communities work.
7. I think creating events would be very useful for me.

Figure 7. Responses regarding the Graasp signup process

On the first option of this survey 4 people strongly agreed that all the questions in the forms are clear, 9 agreed with the premise, and just 1 person stayed neutral about the topic. We

could infer from these answers that the signup forms are well structured and easy to complete.

Only 2 participants out of 14 believed that the forms would discourage them from using the system, contrasted to a slightly higher number of 5 people who thought that these questions could discourage other teachers instead. In general, most of the participants did not consider the forms to be a major problem when registering in the Graasp authoring environment, and 11 out of 14 suggested that the forms were quite concise and easy to fill. Additionally, there was a divided opinion on how the phrasing of the questions was perceived, with a total of 5 people agreeing that they seemed intrusive, 5 considering the forms not to be intrusive at all, and 3 people staying neutral.

For the last two questions where the topics covered the foundation of communities and events, 11 persons out of 14 stated that they understood how communities work, and 13 people thought creating events would be very useful for them. These two new features appeared to be a big success.

To evaluate the signup forms and clauses, the ambassadors evaluated a total of eleven signing up clauses, most of which received total support and were clearly understood, apart from the following clauses:

- Accept that EPFL uses your anonymized data for scientific purposes. (4 out of 9 people disagreed with this option.)
- Accept that EPFL cannot be held liable for any damage resulting from your use of Graasp including any loss of content and data. (Only 1 out of 9 people would not approve this decision.)
- I agree to let Go-Lab & Next-Lab use anonymous data regarding my activities in the project and the platforms for research and improvement purposes. (3 people would agree to this, 3 people are totally against it, and the remaining 3 did not fully understand the question and/or how its real implementation would work.)

Our general observation was that the majority of teachers would happily agree to the list of Terms and Conditions, but their main concern was related to the collection of data about their performance and activities inside the platform, as well as how anonymous the data would be.

7.4.8 Go-Lab Help and Support

The following sections presenting an overall assessment of the findings from the Go-Lab Support/Help Services questionnaire shared with 93 pre-service teachers after face-to-face training (LEIC-23032017, see Section 4.4) has been provided by UCY, who performed the activity, the detailed results can be found in Appendix XX.

The majority of the 48 participants who answered the Go-Lab Support/Help Services questionnaire have used both Go-Lab sharing platform and Graasp (95,8%) and considered themselves as intermediate users, meaning that they have used existing ILSs and created their own ILSs (87,5%). These percentages were expected since the participants were graduate and undergraduate pre-service teachers and they have been trained to use the Go-Lab ecosystem during their major.

In the questionnaire the participants were asked to specify their awareness, usage, and overall experience with the following services:

- Live discussion with a Go-Lab team member in person
- Live video discussion with a Go-Lab team member in the Tutoring Platform (http://tutoring.golabz.eu)
- Emailing a Go-Lab team member
- Direct contact with a lab owner (e.g. through email or forum on the details page of a lab, see the bottom of http://www.golabz.eu/lab/electrical-circuit-lab for example)
- Direct contact with an app developer (e.g. through email or forum on the details page of app, see bottom of http://www.golabz.eu/app/hypothesis-tool for example)
- Direct contact with ILS creator (e.g. through email or forum on the details page of an ILS, see bottom of http://www.golabz.eu/spaces/color-light for example)
- Community forum in the Tutoring Platform (http://tutoring.golabz.eu/forum)
- Forum for improvement suggestions (https://graasp.uservoice.com/forums/108675-graasp-feedback)
- Online course (MOOC) on opencourseworld
- Video tutorials on the Go-Lab sharing platform (http://www.golabz.eu/videos)
- Questions & Answers / FAQ (Frequently Asked Questions) section of the Go-Lab homepage (http://go-lab-project.eu/faq-new-page)
- Tips & Tricks tutorials on the Go-Lab homepage (http://go-lab-project.eu/tps-tricks)
- User manuals on the Go-Lab sharing platform (http://www.golabz.eu/tutorial/user-manuals)

Among the Go-Lab support/help services the most popular ones, in terms of awareness (participant knows about it) and usage (participant has used it), were the “live discussion with a Go-Lab team member in person” (awareness 91.67% “yes” and usage 85.42% “yes”), “emailing a Go-Lab team member” (awareness 87.5% and usage 77.08%), “direct contact with ILS creator” (awareness 77.08% and usage 56.25%) and “video tutorials” (awareness 75% and usage 64.58%). The least known and used service was the “online course” (awareness 22.92% and usage 8.33%). The experience of the users with the most popular services was relatively positive (the percentage of participants rating their “Overall Experience” as “Positive” is between 50% and 85.42% for each one). However, it seemed that the preferable service was the “live discussion with a Go-Lab team member in person”, since all the participants who have used it, reported a positive (41 participants) or neutral (7 participants) experience and none of them reported a negative experience. As for the overall experience of the users for the other services, namely “live video discussion in the Tutoring Platform”, “direct contact with a lab owner”, “direct contact with an app owner”, “community forum in the Tutoring Platform”, “forum for improvement suggestions”, “online course”, “frequently asked questions”, “tips and tricks”, and “user manuals”, it appeared to be mostly neutral (with the percentage of participants selecting the “Neutral” option for “Overall Experience” being between 68.75% and 83.33%). From these results it can be concluded that the users preferred a closer collaboration with the Go-Lab team members (direct contact and emailing). This can be due to the type of the training workshop they had and because the training workshop was part of their course.

For each support or help option the questionnaire also asked for improvement suggestions. The comments here were limited and the most important concern voiced was the language. Specifically, it was suggested to translate the Classroom Scenario Handbook in Greek and to insert Greek subtitles to the video tutorials. In addition, it was suggested to provide more discussions on updates and to have quick replies on emails.

The majority of the participants have never experienced problems in using Go-Lab (79.2%) while less users have experienced a problem once (10.4%) and few times (10.4%). Most of the problems that the users reported concerned the internet connectivity, for example when multiple users were using the Graasp authoring environment some delays were observed, or the loading of the apps was very slow. Another important issue that was reported by a user was the absence of undo and redo options in Graasp. For the solution of a problem, one user reported that he/she communicated with a Go-Lab team member through email while another user has solved the problem on his/her own.

When the participants were asked to rate the necessity of providing posible new support/help desk services, for all options offered the majority showed a high preference towards having them. The overview below shows the percentages for the two most selected answer options for each new service proposed:

- Access to Go-Lab team to get instant responses via chat:

  31.25% **Must have** and 64.58% **Nice to have**

- Email:

  45.83% **Must have** and 47.91% **Nice to have**

- Asynchronous Go-Lab team support forum:

  47.91% **Nice to have** and 29.16% **No harm to have**

- Asynchronous peer teacher support forum:

  56.26% **Nice to have** and 25% **No harm to have**

- Frequently asked questions:

  50% **Must have** and 43.75 **Nice to have**

- System-generated responses:

  35.41% **Must have** and 47.91% **Nice to have**

- Long term support while creating an ILS:

  31.25% **Must have** and 56.25% **Nice to have**

- ILS peer-review:

  41.66% **Must have** and 43.75 **Nice to have**

When they were asked if they would like to have a support/help service that was not mentioned in the list, one participant reported the automatic scientific check of the ILSs during their creation.

The participants who answered the Go-Lab support/help services questionnaire were graduate and undergraduate pre-service teachers and they were trained to use the Go-Lab sharing platform and the Graasp authoring environment during their studies. Because they were expert users of the Go-Lab ecosystem, their opinion was very important for the improvement of the Go-Lab support services. During their experience, they preferred to receive direct support/help from the members of the Go-Lab team. However, they were open to the new services that could be offered to them. Their overall experience with the support/help services was positive, even though they did not know all the available services. Most of the participants did not experience problems using the Go-Lab ecosystem, meaning that they made good profit from their training. However, among their suggestions for

improvement is the awareness for the updates of the ecosystem, the insertion of undo and redo options in Graasp and the translation of the video tutorials and manuals.

During the session dedicated to help and support at the Ambassadors workshop in Brussels (LEIC-06052017a, see Section 4.5), EPFL presented the Intercom helpdesk system and Go-Lab communities before asking participants to fill in an online questionnaire (see Appendix YY for results). The main findings from this session are:

- Existing help and support
    - 100% of the participants knew about the main components of the project (Go-Lab and Graasp). 50% of them created an ILS before and 75% have only delivered ILSs that other people created.
    - Video tutorials were used by 60% of the participants and perceived as very useful.
    - Online courses were used and appreciated by several participants (35%).
    - Forum only used by two users and would not be missed if removed. However, a couple of participants argued that it could be a good facility for general, public questions and encourage interaction. It was explained to them that new features in Graasp could provide the same functionality.
    - Intercom was presented as a possible replacement of the forum during EPFL session. Some teachers did not see Intercom as a replacement, because it does not support interaction between peers, e.g. discussions in groups.
    - Tips and tricks seemed to be not remembered or used by anybody.
    - Less than 20% of the participants spoke about the textual user manuals.
- Intercom
    - Being able to contact experts was perceived as good, especially if they are relevant, respond quickly and in the native language of the teacher.
    - Some ambassadors did not like the idea of becoming experts themselves, workload and time to respond were two issues mentioned.

8. General Findings and Major Themes

As the studies conducted in the first eight months of the Next-Lab project targeted very diverse artefacts and had different goals, ranging from identifying usability issues of single apps (e.g. Viewer app) to testing the acceptance of system components (e.g. registration process) and involved different PD techniques and participants, not all findings can be aggregated and generalized. However, from the different studies major themes emerged that span across different components and aspects of the system.

The most prominent one that came up in nearly all encounters with pre- and in-service teachers or teacher trainers is the time pressure under which teachers have to operate. Besides teaching-related tasks like lesson planning and marking, they have additional administrative tasks like reporting. On the one hand, Next-Lab and the resources it offers are seen as a source of support in this busy environment (e.g. re-use of ILSs, LA apps that help teachers to keep track of their students' work and progress). On the other hand, this may lead to non-adoption of Next-Lab by teachers. As they often have to use the first suitable thing, not the best possible (i.e. they take the first suitable resource found on Google rather than checking the Go-Lab sharing platform for possibly better alternatives) and learning to use the system takes time, which many teachers do not have in their busy day (cf. reasons of pre-service teachers for not using Next-Lab).

Another issue that arose in different studies, being explicitly (i.e. by actively asking about the suitability of the existing apps for primary school students) or implicitly (by primary school teachers participating in the activities exploring the resources and commenting on the suitability for their students) is the incompatibility of some of the Go-Lab resources for primary school students. As such, students have only become a target group in Next-Lab, it is understandable that some adaptations are still necessary to cater for their needs.

When looking at the results of the studies performed during the first eight months of Next-Lab it is encouraging to note that the evaluated artefacts have mostly been perceived positively by the participants. However, the issues identified show that the PD activities are a necessary and valuable contribution to the project work.

9. Adoption

9.1 Adoption of PD Findings by Developers

For the findings and proposed changes presented to them in separate reports, developers and partners interested responded positively and integrated most of them either directly into their systems or after a short clarification discussion with the PD team. Reasons for not integrating the findings were either more clarification from more studies would be required to address them adequately or it was technically impossible to perform the suggested changes. An example response from a developer can be found in Appendix ZZ.

For more recent activities and results (like the ones from the Next-Lab Summer School 2017 in July) this deliverable serves as a report to the developers and other partners. Where necessary the findings will be discussed with the partners prior to implementation actions. This process and the outcomes will be described in the next deliverable.

9.2 Adoption of Re-worked Artefacts by End-users

9.2.1 Barriers

The main barriers or hindering factors identified as preventing teachers from adopting Go-Lab artefacts, based on the observations in several of our studies, are their suitability for students and time constraints. In several sessions, especially primary school teachers would say that the presented resources would not be suitable for their students and asked for variants of the apps, labs or scenarios that would be more compatible for younger students. This issue has already been addressed with the expansion of the focus from Go-Lab to Next-Lab through the added focus on primary school students. The input and feedback presented in this deliverable (e.g. a scenario with three instead of six thinking hats) can be used to guide and further support reaching this goal of broadening the target group that the Go-Lab system is catering for.

The issue of time constraints is harder to address, as it shows on different levels and aspects of the Go-Lab system: information for teachers needs to be easy to find, understand, and apply in the classroom; creating an online lesson can be more time consuming than creating a traditional lesson, especially while the authoring system is unfamiliar; and so on. Consequently, this has to be addressed by different partners of the Next-Lab project, optimizing all parts of the system ranging from search and content presentation on the Go-Lab sharing platform over convenience facilities in the Graasp authoring environment to an efficient help and support system for teachers. The studies presented in this deliverable have covered all of these aspects and their findings can thus serve as a starting point for further and continuous improvement of the Go-Lab system to further support adoption by teachers.

Another barrier for adoption of Next-Lab that became apparent in several of our sessions is lack of technical equipment and slow internet connection at schools. While the latter can be and has been addressed by improving the Go-Lab artefacts to be loaded quicker and to require less data to be sent, there is not much the project can do about the availability of computers for teaching at school.

9.2.2 Facilitating Factors

Besides barriers, the studies presented in this deliverable helped us identify facilitating factors that could support and make teachers adopt the Go-Lab system in their teaching practice. One of the strongest factors are face-to-face workshops in which teachers get

hands-on experience with the system from experts, which they can then apply once they are back in their schools. The online help and resources are perceived as useful. However they cannot replace, but rather work in conjunction with face to face sessions where real-time feedback can be given. The modular system with growing effort of applying only single labs or apps, existing ILSs by other teachers, adapted existing ILSs, own ILSs from scratch and own ILSs from an existing scenario helps to get teachers familiar with the system and gradually apply more and more sophisticated and customized teaching resources in their teaching. PD of the artefacts, to ensure good usability and positive user experience, and a wide variety of teaching topics covered to ensure their applicability are important to facilitate the adoption of the Go-Lab system in the everyday life of teachers.

10. Conclusion

The studies conducted in the first eight months of the Next-Lab project can provide valuable input to developers and educational specialists who aim to enhance various aspects of the Go-Lab system for Next-Lab. Besides reporting usability and other possible issues, indicating potential areas for further adaptations, improvement suggestions were provided about which changes could be made. To further ensure good usability and positive user experience for students and teachers when applying Next-Lab in their learning and teaching, PD activities will be conducted on demand for the remainder of the project.

These activities will continue to be tailored to the needs of the requesting partners. When the time gap between the request received and results expected is short, especially when the purpose is to get feedback on the design of an early prototype, a handful of participants will be recruited and mainly qualitative data will be collected. In fact, for user-based usability and user experience evaluation tests, typically a small number of participants are involved. Nonetheless, when specific services (e.g., help/support) entail a good number of responses to inform their future development, we will utilise additional evaluation resources such as the teachers who have signed up for the Graasp authoring environment and consented to be sent questionnaires (WP2). An additional possible source of user feedback and input that could be explored in the future are comments received via the Intercom support system.

One important topic, which emerged from the findings of several studies with teachers, is the suitability of resources for primary school students. Although we already started to address this question by performing analytical studies and letting teachers rate the existing apps, no studies with end-users (primary school students) have been performed yet. To collect their valuable input directly (in addition to the feedback already gathered from surrogates), we will focus our efforts on approaching schools to run PD workshops with students there. This will provide useful input on student needs not yet covered by Next-Lab resources and can therefore support partners in reaching the Next-Lab goal of providing resources to younger students in addition to the age groups already covered during the Go-Lab project.

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12. Appendices

A. Additional Results from the Hands-on Next-Lab Workshop for Pre-service Teachers (LEIC-27022017)

Besides feedback on the GoModel tool presented in the main body of this deliverable (Section 7.1.1), additional, general feedback on the workshop and the Next-Lab project has been collected from the participants of this session:

- 10 out 12 participants found the workshop to be informative and were interested in engaging with the project further.
- 11 of them believed the Next-Lab facilities and resources could be an asset on their teaching and were interested in writing their own ILS for future use in the classroom.
- General negative comments involved the difficulty to use or understand some parts of the system (particularly after only having attended to one workshop); the limited access of students to computers and the Internet; the not always compatible displaying of contents on different browsers; and the lack of assessment tools.
- Positive comments remarked the advantage for teachers of being not only able to create an ILS but also to use other's; the usefulness of the platform for a flip learning activity; the ability to interactively give students tasks and guidance; the benefit of having ready to use online labs, as well as simulations and games that could engage (especially bright) students to pursue deeper learn about a topic.
- Regarding the modelling tool, most pre-service teachers could understand the purpose of the tool and could be using it in their own teaching as well as envisaging other teachers wanting to use it. Overall, it would seem that these teachers believed that the tool has potential but some usability issues ought to be improved. For a detail report of the results for GoModel please refer to Section 7.1.1).

The event where these results have been gathered is described in Section 4.2.

B. Details on Face-to-face Training Received by Pre-service Teachers Answering the Go-Lab Support/Help Services Questionnaire (LEIC-23032017)

This section provides more details about the training that the participants went through and how they were expected to use the Go-Lab system after the training activities. At this point it should be noted that the training events were part of the science education curriculum of the University of Cyprus for graduate and undergraduate students in science education majors. Thus, two training events took place, one at the end of the winter semester of 2016 and one at the spring semester of 2017.

The first training event was included in the master course “The Process of Inquiry in Natural Sciences” and the participants were 26 pre-service teachers of several disciplines – 14 pre-service primary teachers, 2 pre-service and 2 in-service biologists, 3 pre-service and 2 in service physicists, 1 environmental education teacher, and 2 kindergarten teachers. All the participants were familiar with the Inquiry Based Science Education (IBSE), the inquiry cycle framework and its five phases. The training event lasted two three-hour meetings and the schedule included:

- Introduction to the Go-Lab sharing platform: Search and try online labs, apps and inquiry spaces
- Introduction to the Graasp: Account creation and exploration of its potentials
- Publication of an Inquiry Learning Space in the Go-Lab sharing platform

After the training event, the participants created Inquiry Learning Spaces in group of 2-5 members and individually. All the ILSs were presented in the plenum and the owners were provided with feedback from peers and experts (teaching staff). The feedback included suggestions for changes and improvements. After the improvements, many of the students published their ILSs in the Go-Lab sharing platform. In total, 34 ILSs were created from which 8 were created in groups and 26 individually. From those 34 ILSs, 26 were published in the Go-Lab sharing platform.

The second training event was included in the undergraduate course “The Teaching of Natural Sciences” and it was completed after all users could create their own ILSs (>2 days). The participants were 67 undergraduate students and they were trained for more than 6 hours. The schedule of the event included:

- Introduction to the IBSE and the inquiry cycle
- Demonstration of the Go-Lab sharing platform
- Practical experience with Go-Lab sharing platform: In which one of the phases of the inquiry cycle each app of the Go-Lab sharing platform is suitable?
- Introduction to the Graasp: Account creation and exploration of its potentials (e.g., edit profile, create an ILS, add items and spaces, share a space, etc.)
- Duplication of an ILS

The goal of the last activity of the training event was to allow participants work on the creation of an ILS and encounter their own difficulties while, the instructors were more flexible to provide help and guidance whenever needed. The ILS was given to them by the instructor and included many items (e.g., configured apps, a lab, videos, images, documents) and many specific functions (e.g., text formatting, hidden text, hyperlinks).

After the training event, the students created their own ILSs in groups of two, to use it with a primary student in the context of a science fair event. The preparation of the science fair

event lasted about one month and at the end the undergraduate students with their primary students had the opportunity to present their work to the others through posters and interactive activities. At this point, it should be noted that at the end of the course, many undergraduate students had published their own ILSs in the Go-Lab sharing platform.

The event where these results have been gathered is described in Section 4.4.

C. General Feedback on Next-Lab Gathered at the Ambassador Workshop in Brussels (LEIC-06052017a)

At least 2/3 of the participants were very pleased with the new features available on Graasp. The exact feelings responses were:

- For the Intercom (see Table 5)

Table 5. Responses to the question for Intercom

0	1	4	8

- For communities (see Table 6)

Table 6. Responses to the question for communities

0	0	5	8

- For the creation of events (see Table 7)

Table 7. Responses to the question for the creation of events

0	1	3	8

- For the registration forms (see Table 8)

Table 8. Responses to the question for the registration forms

0	4	1	8

Some concerns raised during the session were:

- the lack of real practice due to time restrictions (e.g. ambassadors would have liked to create their own events and gain some experience on how to do it)
- the language settings for most units (e.g. registration forms are in English only and some teachers back in their own home countries do not fluently speak or understand the language)
- the difficulty of access to some artefacts (e.g. some of them struggled to find the specific place where to create new events, others thought it was not intuitive how to make the time selection).

The event where these results have been gathered is described in Section 4.5.

D. Questions and Responses of Next-Lab Feedback Workshop for Pre-service Teachers (LEIC-22062017a)

First set of questions

Did you use Go-Lab?

Out of 28 student teachers, about 25% (7 persons) tried the Go-Lab services after our workshops. All of them encountered issues while creating or delivering a lesson, so there were not any successful examples. Some of the problems they described include the difficulty for kids to understand the simulations, or the ineffective performance of the selected labs (e.g. temperature, solar system, speed and distance, etc.).

The remaining 75% of participants did not try any Go-Lab features or services.

Any reason why not?

Time seems to be the teachers' main concern. They believe that it is too time-consuming to plan a whole lesson on Graasp/Go-Labz, plus it takes them significant effort to understand or remember how things work.

Teachers also find some of the concepts or labs too difficult for their pupils, especially if kids are under 12 years old.

Schools do not always have access to the technologic needs and equipment required by the project, so teachers can see tools being presented as demos rather than students hands-on experience. However, after experienced some errors within the application, most of them feel there is no guarantee that everything will work fine during a class, so they prefer to avoid this risk and use either other online materials or do deliver a normal lesson.

As participants were student teachers, some of them do not know which topics they will be teaching in real schools yet, so they have not had a look at the topics available on the Go-Lab sharing platform.

Any ideas for whether / how to better engage next year's Postgraduate Certificate in Education (PGCE) cohort?

The majority of participants suggested to approach the students earlier in the year, when they are more motivated and have some free time. Teachers would want researchers to initially show the basics of the project by giving them examples and letting them play or have a go during the very first session. Perhaps they could have an activity sheet to prepare before the workshop so they get familiar with Go-Lab features and during the workshop/session presenters could show them how everything works by switching roles (they could act as students and see how the implementation of their previous efforts work in a specific, more real scenario). Another suggestion was to use Go-Lab as an optional science directive class or even as homework during their studies. The idea is that at the end of any session, they could come up with a complete online lesson using interactive methods.

Input to these questions from the sessions dedicated to other sets of questions:

Idea for next time: Offer a session where every participant goes away with one fully functional ILS, which they can use in their teaching straight away.

Second set of questions

- Any of you interested in utilising this in newly qualified teacher (NQT) year?
- Would you like to attend a twilight session to learn the skills of writing ILSs if we organize one?
- Would it be helpful for us to assist/support you as you develop your ILS?
- Would it be appropriate or possible for us to attend while you deliver the lesson?

To which participants answered:

- Looks excellent, especially for experiments where real equipment is unavailable or too expensive or fragile, or time-consuming to use.
- Could also be useful for low ability groups
- Some perceived obstacles due to limited IT facilities in schools. E.g. poor internet, or completing with other teachers to book just the one computer room.
- Another obstacle – it needs to be much simpler to use, without extensive training.
- Everything needs to work. If the first lab a teacher tries does not work, they may be put off forever.
- High level of enthusiasm for using it in probationary year. (Sign-up list)
- Very interested that we have funding to provide free support
- Lots of interest in twilight session, especially if buffet provided, though one group also strongly suggested webinars so they do not have to travel.
- Want a session where we start with the very basics – simple example.
- Best start is for us to act as science teachers and the teachers act as students, learning some science by doing a Go-Lab lesson.
- Help and assistance (in person or online or by phone) while writing ILS is very popular.
- Observing and supporting a Go-Lab lesson delivery seemed possible in some schools. One teacher said Disclosure and Barring Service (DBS) essential.

Third set of questions

- Having spent time in schools, do you think Next-Lab has potential? Who would it appeal to most? What obstacles do you envisage?
- Do you know of any teachers, lab assistants, etc., who we could contact that may be interested in joining the project?

The answers, clustered by groups, were as follows:

- Group 1:
    - Wanted to use it, but school did not have enough iPads and only a few computer rooms, which were already reserved for ICT lessons.
    - Issues at school: Students forget their logins, thus it takes half the lesson to set up PCs and get the students to even start working with anything PC-related.
    - Online lesson is “one more thing that can go wrong”. We cannot even rely on our projector to work, thus online lessons are an additional risk to take in the classroom.
    - An obstacle of using it at school is the filter functionality on the Go-Lab sharing platform. As a UK teacher I would need to find resources by searching for a specific key-stage and school level.

- Group 2:
    - There is just so much out there and if you have to create your lesson in 30 minutes you tend to grab the first thing you find. Next-Lab is not always on our mind.
    - Do more advertisement, because teachers at the placement schools (other than the student teachers who had an introduction session) do not seem to know about Next-Lab.
    - Availability of computer rooms asks for coordination between teachers (as do other labs and lab equipment).
    - Light mixing lab on Go-Lab sharing platform was too advanced for my students. I struggled as an adult to understand what is going on.
- Group 3:
    - Would like to use it, but we do not know how to use it.
    - Takes too long to work out how to use it.
    - Takes too long to create a lesson
    - Equipment at the school: Only one PC room and I could not get it, because it was already booked out for the entire time of my placement.
    - Create a video for students on how to use an ILS. Besides providing students with additional support, this video could also be watched by teachers to get to know how students are supposed to work with an ILS.
    - Next-Lab team should come to schools during half-term and offer a workshop creating an ILS that will be used in class the following week. This way teachers would become more confident on how to use it.

The event where these results have been gathered is described in Section 4.7.

E. Details on End-user Evaluations of Seesaw Lab (LEIC-27062017)

The first session on 27/06/2017 was performed with two male participants and lasted from 15:00 to 16:05. The second session on 28/06/2017 was performed with two female participants and lasted from 16:30 to 17:50. None of the participants was a native English speaker.

Each session started with a brief explanation of the Next-Lab project, followed by a short introduction to the ILS. To get unbiased input no details about the functionality of the ILS and its components were revealed, the facilitators only communicated the general idea that the two participants would work together collaboratively to answer the questions in the ILS.

- Equipment
  - Two PCs running Windows 7
  - Screen resolution: 1680 x 1050 (left side of Seesaw ILS) and 1920 x 1080 (right side of Seesaw ILS)
  - Browser: Google Chrome

The participants then logged in to the ILS (left[12] or right[13] side respectively) with self-selected usernames. The facilitators created a SpeakUp room and provided the room number to the participants:

- Session 1:
  - Room name: Evaluation01
  - Room number: 62948
  - Nickname participant left side: Paul
  - Nickname participant right side: Mirzhan
- Session 2:
  - Room name: Evaluation02
  - Room number: 75147
  - Nickname participant left side: Bara
  - Nickname participant right side: ya

The participants then worked through the ILS phase on their own (being observed by one facilitator each; one facilitator observed the left side of the Seesaw in both sessions, the other one the right side). The facilitators mostly only remembered the participants to think aloud and only interfered with the task when the participants got stuck. After the participants successfully answered all four questions in the ILS, the facilitators would then ask both of them in a final discussion for any remarks they did not yet make during the session.

Detailed notes from the think-aloud comments were taken and any other observation was documented. For reporting the collected feedback and ideas were assigned to the elements of the ILS to allow for addressing by the respective Next-Lab partners. Like it is done for usability observations from analytical studies, the usability observations from the end-users have been rated regarding the importance of fixing these issues (with low, medium, or high, see Section 2.2.3 for details).

When comparing the user-based results with the results from the HCI analytical walkthrough (see Section 7.2) some overlap can be noticed, but the user test also revealed some new issues, which did not occur during the analytical walkthrough.

The event where these results have been gathered is described in Section 4.8.

[12] http://graasp.eu/ils/5943d68616d1ef2147b8a209/?lang=en

[13] http://graasp.eu/ils/5947b78916d1ef2147c666da/?lang=en

F. LA Apps Questionnaires Used at Next-Lab Summer School 2017 (LEIC-11072017a)

On 11/07/2017 the ULEIC team did, in collaboration with EPFL, an evaluation of the Go-Lab LA apps[14]:

- To identify which LA apps teachers find useful
  - In general
    - For awareness
    - For reflection
    - For self-assessment
  - In a flipped classroom scenario
  - For giving feedback to students
  - To keep track of the class progress
- To evaluate their overall usability and user experience

After a general presentation of the Learning Analytic apps and other teacher utilities for classroom management, participants were asked to fill in two questionnaires. Participants used their own devices (laptops and tablets) during the session, the questionnaires were created using Google Forms and distributed using tiny urls. The first one contained questions regarding LA apps used by students[15] (Figure 8, left), and the second one regarding LA apps designed to be used only by teachers[16] (Figure 8, right).

[14] http://www.golabz.eu/apps?f[0]=field_app_category%3A7485

[15] https://goo.gl/forms/VfTaoWCsZFZE7Qkd2

[16] https://goo.gl/forms/w7f57E6iFRT90fh83

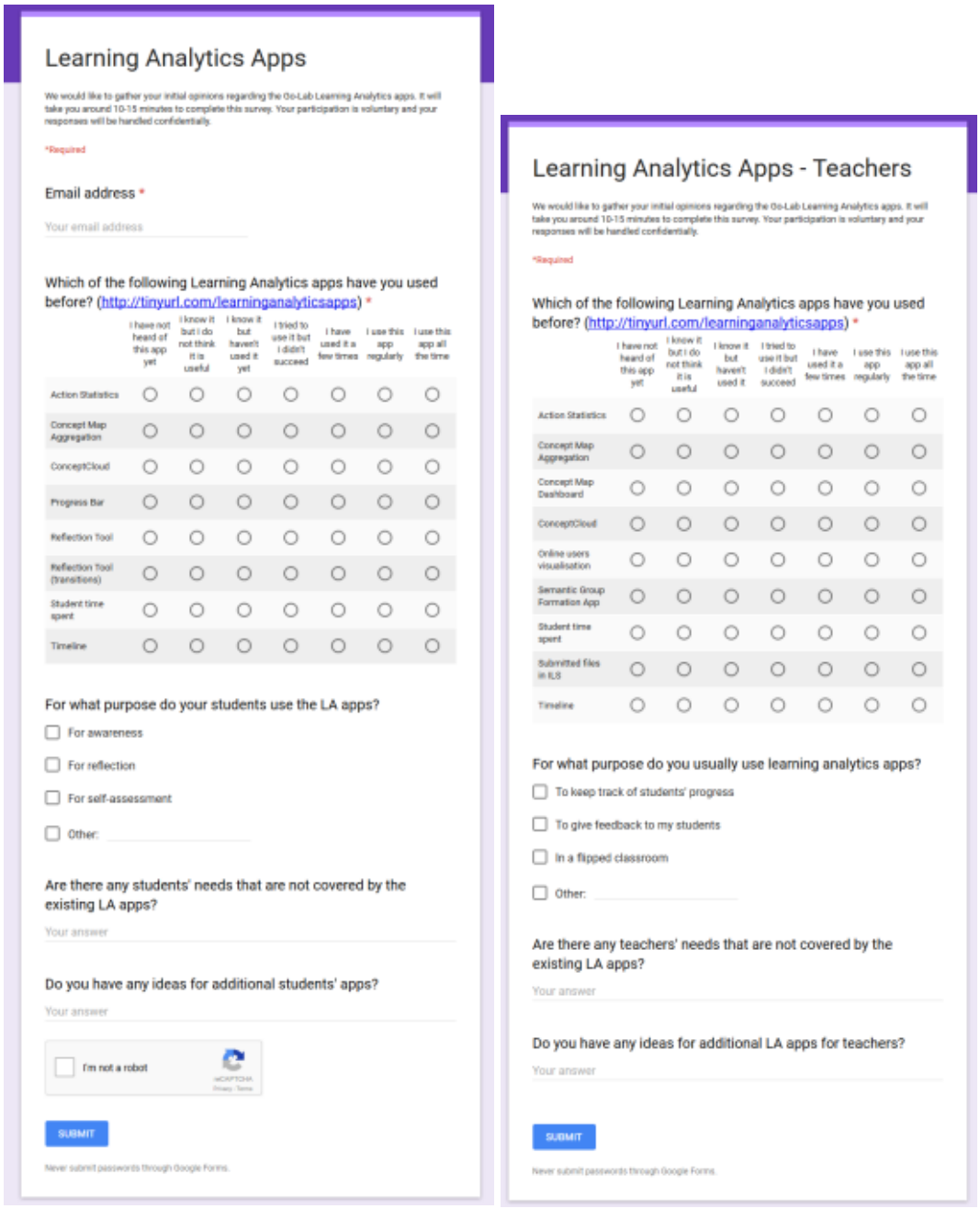


Figure 8. Questionnaire on LA apps for students (left) and teachers (right)

The event where these results have been gathered is described in Section 4.9.

G. LA Apps Sticky Notes Activity at Next-Lab Summer School 2017 (LEIC-11072017b)

In preparation of the workshop, all LA apps were tested and five of them found to not be working properly:

- Reflection tool
- Reflection tool (transitions)
- Concept Map Dashboard
- Group Formation app
- Timeline

The developers of these apps were informed about this issue and took actions to identify and address the problem.

On 11/07/2017 the ULEIC team did an interactive evaluation of the Go-Lab LA apps[17] to gather comments on positive user experience, negative feedback, improvement suggestions, and input on relevance of LA apps.

After a short period of group work in which the teachers were able to develop their ILSs and integrate some of the LA apps presented during the morning session (see Appendix F), participants were asked to rate the existing LA apps. The rating dimensions where:

- Necessity (on orange sticky notes)
- Suggestions (on yellow sticky notes)
- Negative comments (on red sticky notes)
- Positive comments (on green sticky notes)

Teachers were paired up and assigned one of the LA apps to start with randomly by drawing numbers from 1 to 12 (each number was available twice to create pairs from the 24 participants). Each pair of participants then got a set of four coloured sticky notes for each LA app. Relevant information about the apps was printed out and stuck to the walls of the venue. They then were instructed to rate the current LA app within two minutes before being asked to move on to rate the next LA app until they reached the one they started with again. While doing the rating teachers had the option to leave sticky notes blank and not attach them to the wall next to the print-out of the current LA app if they couldn't think of anything for this rating category (e.g. if the participants had no positive comments for a specific LA app, they could have omitted putting a green sticky note there). The researchers mingled to answer questions the participants might have about the apps or the process of providing feedback. Figure 9 shows an example result of this activity.

[17] http://www.golabz.eu/apps?f[0]=field_app_category%3A7485

Figure 9. Example for feedback on and rating of a LA app using sticky notes

The event where these results have been gathered is described in Section 4.9.

H. Booklet Activity on ILS Publishing Process at Next-Lab Summer School 2017 (LEIC-11072017c)

On 12/07/2017 the ULEIC team did a PD session on the ILS publishing process to gather feedback on the new interface, compare the new and old publishing facilities, and inform teachers about common mistakes, making them aware of how to avoid them as basis for a short discussion.

Following a quick review about the steps to follow for publishing ILSs, booklets containing screenshots of the old and new publishing procedures and their respective interfaces were given to participants to provide written feedback (see Figure 10). Teachers were then asked to work in groups of 2-3 and compare the old process/screenshots to the proposed new design. They would go through the old process on their own devices and note down feedback and comments on old and new process in the booklet.

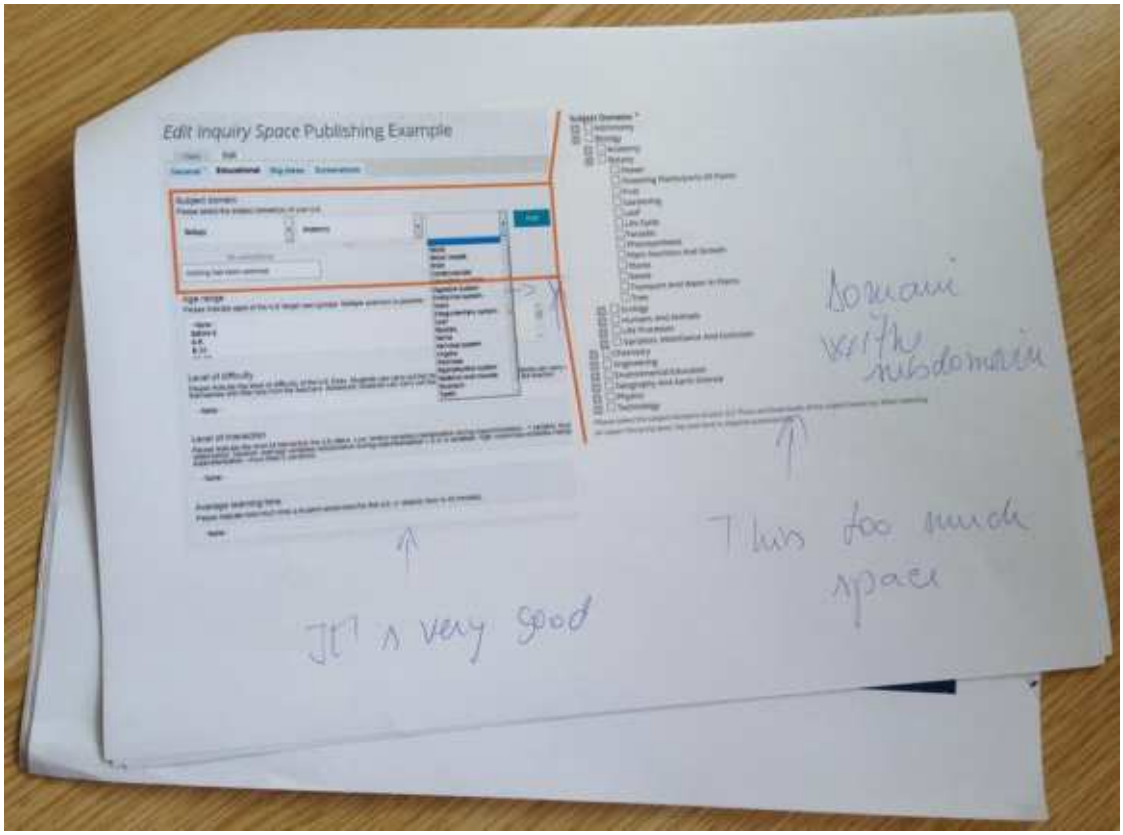


Figure 10. Booklet used to gather feedback from participants about the ILS Publishing Process

The event where these results have been gathered is described in Section 4.9.

I. PDotCapturer Activity on Scenario Integration at Next-Lab Summer School 2017 (LEIC-11072017d)

On 14/07/2017 the ULEIC team ran a PD workshop at the Next-Lab Summer School 2017 to evaluate the integration of scenarios in the Go-Lab sharing platform, the description of each scenario, and the integration of scenarios in the Graasp authoring environment. After presenting the task of giving feedback on the scenario integration to the participants and giving them a live demo on how the PDotCapturer tool works, the participants were asked to work in pairs to provide feedback. Credentials to access the PDotCapturer were given out to the participants and they were asked to open the URL http://tinyurl.com/pdscenarios in their browsers. In PDotCapturer screenshots of the scenarios on the Go-Lab sharing platform and the Graasp authoring environment were presented for the teachers to provide feedback and re-design suggestions. The researchers mingled with the participants to answer any questions or help out in case an issue was encountered.

The event where these results have been gathered is described in Section 4.9.

J. Email for CGT: Keywords (LEIC-00032017)

Hello dear teachers, and thank you for agreeing to take part in Core Group online activities. This is really useful for the project, as your expertise and views and opinions are based on real up-to-date classroom experience. We will only send you these activities if we have a genuine need for your expert input. We hope also that some of the activities and tasks we send will be useful to you in showing you new features of Go-Lab / Next-Lab which you may not have seen before. In some cases they will be prototypes, so you have a real influence in shaping the final version of new features.

Today I have a task which is rather subtle but far reaching in its impact on the system. It is about the use of keywords on the GoLabz portal. The link to the task is here:

https://docs.google.com/forms/d/e/1FAIpQLSdhyf_sPJJpIZOiKLT-gnhgMdF5bAakXQ_cH4kYynttNS7gRA/viewform

We'd be very grateful if you could follow the link, read the small piece about keywords and respond to the questions. If you could do so by Monday 3rd April) that would be splendid.

In future, based on feedback, we plan to send out activities like this on Thursdays wherever possible, no more than once every two weeks.

Thanks in anticipation,

Rob

on behalf of the University of Leicester Next-Lab team: Effie, Matthias, Pamela and myself

To see all questions and the responses see Appendix KK.

The activity for which this email was sent is described in Section 5.1.

K. Email and Details for CGT: Suitability of Apps for Younger Students (LEIC-23062017)

Dear Next-Lab core group and PD teachers,

Thank you very much for your interest in supporting the NextLab project by providing your expert input and insights into the usability and usefulness of different components. If you know of any other teachers with Go-Lab expertise who might be willing to support us in the same way, please do let us know.

We are proposing to resume a process we applied in the previous Go-lab project of emailing out activities no more than once every two weeks on a Friday. We will only request your expertise if we have important questions to be answered. The brief activity often consists of a request to use some component of Go-Lab followed by a questionnaire or similar means of providing feedback.

This week's task concerns the suitability of our Go-Lab apps for younger students (age 8-11). Even if you don't teach that age group your input from a teacher perspective would still be very valuable to us. The attached spreadsheet explains the task in detail. If you can, please do the task and return an updated version of the file to me by 03/07/2017.

To keep the duration of the task low, we split you in 2 groups and would thus ask you to please rate (at least) the first half of the entries in the attached file (row 3 - 23, but feel free to continue if you like, the more input we can get the better). In case you don't know an app by its name, you can click on the link to go to the full description on the golabz portal.

Please don't hesitate to ask in case you have any questions or encounter any issues.

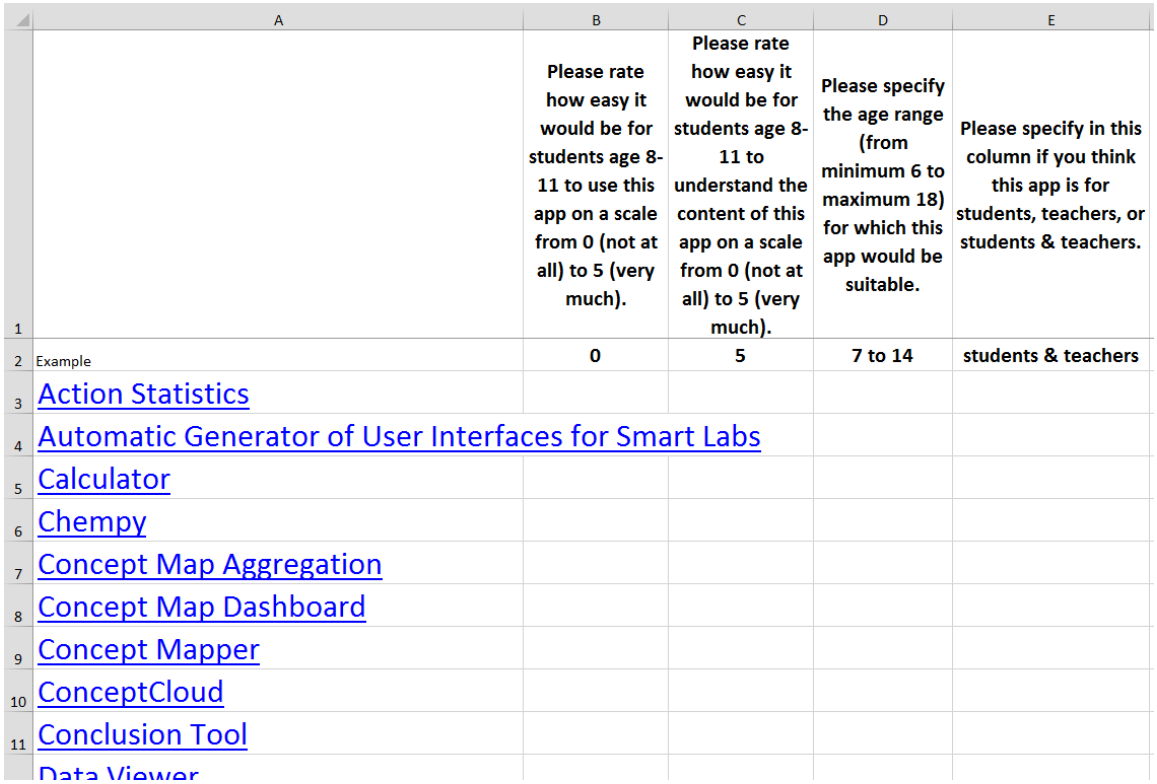
Best regards,

Matthias, for the University of Leicester team

As categorizing all 42 existing apps would have been too exhausting for each teacher, the Next-Lab core group and PD teachers were randomly separated in two groups, which each did half of the apps, resulting in each teacher only having to rate 21 apps. The 42 apps were sorted alphabetically for this and then one group got the first half of the list, the other group got the second half (they got the list sorted descending and then were asked to rate the top half).

To perform the rating of the apps, an Excel file (Figure 11) was attached to the email above, which contained a list of the existing Next-Lab apps in the rows and for each app the following four tasks in the columns:

- Please rate how easy it would be for students age 8-11 to use this app on a scale from 0 (not at all) to 5 (very much).
- Please rate how easy it would be for students age 8-11 to understand the content of this app on a scale from 0 (not at all) to 5 (very much).
- Please specify the age range (from minimum 6 to maximum 18) for which this app would be suitable.
- Please specify in this column if you think this app is for students, teachers, or students & teachers.



	A	B	C	D	E
1		Please rate how easy it would be for students age 8-11 to use this app on a scale from 0 (not at all) to 5 (very much).	Please rate how easy it would be for students age 8-11 to understand the content of this app on a scale from 0 (not at all) to 5 (very much).	Please specify the age range (from minimum 6 to maximum 18) for which this app would be suitable.	Please specify in this column if you think this app is for students, teachers, or students & teachers.
2	Example	0	5	7 to 14	students & teachers
3	Action Statistics				
4	Automatic Generator of User Interfaces for Smart Labs				
5	Calculator				
6	Chempy				
7	Concept Map Aggregation				
8	Concept Map Dashboard				
9	Concept Mapper				
10	ConceptCloud				
11	Conclusion Tool				
	Data Viewer				

Figure 11. Screenshot of the Excel sheet send to the teachers to do the rating

The activity for which this email was sent and with which these results have been gathered is described in Section 5.2.

L. Email for CGT Task: Chat (LEIC-07072017)

Dear Next-Lab core group and PD teachers,

Thank you very much to all of you who replied to the task of rating our apps regarding their suitability for young students. From your responses it looks like only a few are and most need at least some teacher support or are not at all suitable (yet). We will take this into consideration for our goal in the Next-Lab project to also include primary school / younger students in our activities and address them with the resources we provide.

For this week's task we would like you to fill in a questionnaire regarding Chat functionality in ILSs. To allow for remote collaboration and to foster 21st century skills (communication), we want to enhance ILSs by providing teachers with the option to add Chat functionality in their online lessons. To find out the best way to do this we prepared the following questionnaire: https://goo.gl/forms/UDqSqA9riaNbTCjH2 .

If you have any additional comments regarding chatting in ILSs that are not covered in the survey, please email them to us!

If you could please respond to the questionnaire by July 17th, that would be great and much appreciated!

Thanks for your support,

Matthias, for the University of Leicester team

The questionnaire questions can be found in Appendix QQ.

The activity for which this email was sent is described in Section 5.3.

M. Email for CGT Task: Scenarios

Dear Next-Lab core group and PD teachers,

I hope you are having a nice summer and a relaxing break. This week's task description is longer than usual, but mainly because we are introducing the PDotCapturer tool, which we would like to use in the future as well to capturer your feedback. Thus if you have any issues with or feedback on this tool, please let us know!

Today we would like to gather your feedback regarding the Go-Lab scenarios. These have been developed as an alternative option to starting your ILS from scratch.

Task 1: Background information

To start we would like to collect some background information (please answer these questions in a reply to this email):

1.) Have you heard of Go-Lab scenarios before?
2.) Which scenarios have you used before?
3.) For which cases do you prefer to start with an empty ILS (basic scenario) and when do you like to start with one of the other scenarios?

PDotCapturer

To collect detailed information on the presentation of the scenarios in the Go-Lab portal, the description of each scenario on the website, and the integration of the scenarios in the Graasp authoring facility we are using PDotCapturer. This tool presents screenshots of the portal pages presenting scenario information and allows you to create markers on any position on this screenshot to add a comment, improvement suggestion or other remark. Besides a textual response you can also create a drawing to express your feedback. For detailed information on PDotCapturer please see the following "ILS": http://graasp.eu/ils/54f44b7a8cd7e5edb8e86183/?lang=en (especially the video on how to provide feedback in the "Giving feedback using PDot" tab. Please be aware that the video has been created with an earlier design of the tool, so it looks slightly different for you, but the functionality is still the same).

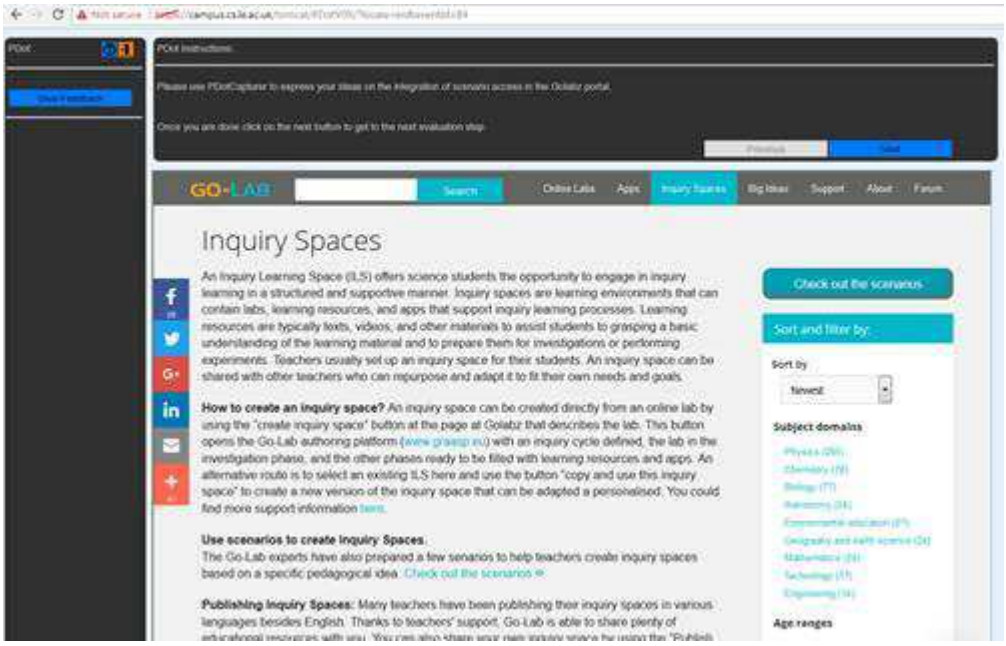
Task 2: Providing feedback using PDotCapturer

Please open the following URL in your browser (preferably Google Chrome, but all major browsers work): https://campus.cs.le.ac.uk/tomcat/PDotV09/?locale=en&eventId=84 then allow "insecure content" (it is not really insecure, it is just on a different website than the PDotCapturer tool, which causes your browser to present this message) and log in with the following credentials:

Username: XXX

Password: XXXXX

Your browser should then show the following:



(if you don't see the GoLabz portal screenshot but only white in the bottom right hand area of the screen, you have to allow insecure content in your browser)

The screenshots are not interactive, in case you would like to try out the real pages while providing feedback, please go to the GoLabz portal: http://www.golabz.eu/spaces

Please provide your feedback on

- The integration of the scenarios in the GoLabz portal (presented on the first two screenshots/instruction steps), e.g. is it easy to find the scenarios on the portal? Should they be made more prominent? Are the descriptions easy to understand? …
- The descriptions of the different scenarios (presented in screenshot/step 3 to 8), e.g. are the descriptions easy to understand? Too long/too short? Are they enough to apply the scenario in your teaching or would you need more information? Could the structure of the text be improved? …
- The integration of the scenarios in the Graasp authoring facilities (Graasp is presented in the last instruction step), e.g. did you have any issues when working with an ILS created from a scenario?

If you have any issues on how to get started and work with PDotCapturer or any other questions, please don't hesitate to contact us. If you could provide your feedback to this task by 14/08/2017 this would be great and much appreciated.

Thanks for your support,

Matthias, for the University of Leicester team

The activity for which this email was sent is described in Section 5.4.

N. Details on Analytical Study of Seesaw Lab (LEIC-22062017b)

- One laptop computer and one PC running Windows 7
- Screen resolution: 1680 x 768 (on laptop) 1680 x 1050 (on PC where lab was tested)
- Browser: Google Chrome (laptop) and Mozilla Firefox (PC)

- SpeakUp chatroom name: HCIAnalyticEvaluation
- SpeakUp chatroom number: 25675
- Nicknames for left side: Matthias and Nick [when trying out what happens if more than one student logs in to the same side of a single Seesaw Lab]
- Nickname for right side: Rob

The event where these results have been gathered is described in Section 6.3.

O. Detailed Results on GoModel from Hands-on Next Lab Workshop for Pre-service Teachers (LEIC-27022017)

Due to the sound system in the room not working properly, the video could unfortunately not be successfully played. Instead, a live demonstration was given which covered mainly the same materials. Some teachers therefore did not respond to Q1, Q2 & Q3, or gave neutral responses. The results are presented in the following tables (Table 9, Table 10, Table 11, and Table 12).

Table 9. Responses from the GoModel worksheet (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

ID	Statement	SD	D	N	A	SA	Comments
Q1	I found the video to be clear and understandable		1	4			(N) Video not viewed. The explanation was okay considering it wasn't prepared. / (D) Still not sure how to use it or how to implement it in teaching.
Q2	My pupils would find this video clear and understandable			5			
Q3	Is the video an appropriate length for use with your pupils?						A little too long (2) "Could perhaps be broken up into stages or given more examples" / A little too short (1) "Explanation wasn't detailed enough".
Q4	I understand the purpose of the modelling tool		1	1	9	1	(D) I don’t fully understand how to use it / (A) It's clear how it could benefit, once you've figured out how to use it. / (A)The purpose of the modelling tool is clear, but the current presentation is clunky. /(A) I think as a modelling tool it would be far easier if you could write the equations and the models were then auto-generated. / (A) I think the idea is good to be able to allow students to create model scenarios. Probably more suitable for KS4+. {Researcher note: in the UK, Key stage 4 is pupils aged 14-16.} / (N) Easy to set up and demonstrate correlations between different variables.
Q5	My pupils would understand the purpose of the modelling tool	1		7	4		(N) Still in early stages. / (N) I think the modelling tool would be primarily teacher-led except perhaps at A level. {Researcher note: A level is UK qualification usually taken at age 18.} / (A)Student may find it interesting and purposeful to understand the interdependence of variables. / (SD) I think it would be time-consuming for students to make their own model. / (N) Assume year

ID	Statement	SD	D	N	A	SA	Comments
							10+, probably. {Researcher note: Year 10 in English schools is age 14-15} / (N) Not sure
Q6	The modelling tool could be useful for my teaching			4	7		**How might you use it?** (A) I like the idea behind it if clearer instructions could be given / (A) To illustrate a change over time to produce a graph; e.g. chemical reaction times or products to reactions / (N) I would use it to demonstrate scientific relationships, so long as it was not time-consuming. / (Unanswered) I think populations as shown; also for velocity. / (N) I would need to practice a lot with it as it's not my natural skill-set, but can see that I might depending on the topic. /(N) If the model was already made and they just had to read off the graph it might be useful. Or if they could change specific inputs. / (A) I'm not sure; unclear as to efficacy currently.
Q7	The modelling tool could be useful for other teachers			2	8		**In what context would it be more useful?** (A) Model things that perhaps could not otherwise be visualised. But could also use to show numerical relationships behind things we can visualise in other ways. / (A) especially teachers who enjoy playing around with "tech" / (A) Once the system becomes more accessible, it would be useful across disciplines. / (N) Looking at relationships / (A) After using an ILS. (Could students share this with me as a teacher to demonstrate their understanding?)
Q8	The tool is easy to use	3	6	1	1		**Is there anything we should change to make it easier?** (D) Looks fiddly and would take me a few goes to become confident. (D) there needs to be a tutorial or better help system. Explain the different symbols clearly. (D) Needs more intuitive controls, and an "equation" edit section to generate the maps would be excellent. / (SD) I don't understand the names Stock, const and aux. / (D) the purpose could be explained better, or be able to input icons - e.g. rabbits - to make it easier.
Q9	The tool works well	2	1.5	4.5	2		**Anything which could work better?** (D) Help tool that is working. / (SD) I think it's too hard for the school students to come up with their own model. Could be useful if

ID	Statement	SD	D	N	A	SA	Comments
							model already made. / (SD) User interface / (N) The linking of expressions to make graphs. Also the equations tab.
Q10	Anything we should add, remove or change						Help tool; Graph on same page as model. / I think you should include a step-by-step tutorial where a new user actually tries it out and gets feedback. This feels very niche. I think I would look for ready-made online labs or apps. / Definitions of the icons - e.g. "dependent variable". A worked example for our students to see. Have a couple of simple "how-to" rules at the side or in Help. (E.g. need to go green and settings to apply). / Include a simple worked example. Have a simple, intuitive way of deleting connections. {Researcher note: I think this refers to the difficulty of deleting an arrow from the diagram, which is virtually undiscoverable for arrows joining two symbols, and impossible for arrows joining a symbol to an hourglass in the middle of a line} / The ability to change icons into pictures (edited by teachers; e.g. choose to provide students with pictures of a sun for amount of sunlight, or a thermometer - to support students with low literacy.

Table 10. Annotations on the GoModel screenshot in the worksheet

ID	Comment
A1	Stock, Aux & const are not terms I would use regularly. Perhaps different descriptors, especially for "stock" and "Aux". Perhaps link to "dependent" and "independent" variables.
A2	"Removable" (pointing to one of the arrows) {Researcher explanation: some teachers could not figure out how to remove an arrow from the diagram}
A3	"Title?" (pointing to "Model results" above the graph)
A4	"Units?" (pointing to the scales on the axes of the graphs) {Researcher note: students in the UK are taught that a graph must always have specific units on the labels of the axes. E.g. not just "time" but "time in days" (or "time in hours" or else) }
A5	Participant drew a button in the top left hand corner of the modelling screen, and labelled it "Toggle immediate edit", and explained it as follows: "As soon as an element is put on the model the edit screen opens if the box is toggled". Also added a button to left hand toolbar above cog wheel and below arrow, labelled "DELETE", and provided the following descriptions: "Click on DELETE, then anything you click on is deleted"

Table 11. Workshop observations

O1	The arrow symbol in the toolbar is very confusing to use. All other items in the toolbar can be dragged to the diagram, but the arrow icon is a button which changes mode, and then an arrow has to be dragged. No-one guesses this right first time and some people never guess it until it is explained. / It is not intuitive, how to add arrows (highlighting arrow symbol and then drag a line from one variable to the next.
O2	The notion of "anonymous variables" represented by a cloud was not readily understood. / The concept of "anonymous" variables would be really hard to grasp for students (comment from a teacher who's next placement is with 11 to 13 year old pupils). For the rabbit example it would make sense to think the arrow comes from the rabbit population and goes into the rabbit population (as that's where the newborn rabbits are coming from).
O3	The method to delete an arrow between two icons (by drawing the arrow in reverse) is unintuitive and unguessable. No-one discovers it without being told, and then they sometimes dislike it. / It is not intuitive (create an arrow between two variables in the opposite direction) how to remove arrows.
O4	No-one, including the researchers, found a way to delete an arrow which connects an Aux icon to the hourglass symbol in the middle of a line. / It is impossible (at least we did not know/find out) how to remove arrows (for the latter between an Aux variable and the valve)
O5	The rubber icon deletes everything, slightly disconcertingly!
O6	One participant asked, how you edit a variable (despite me showing double clicking on it opens the respective dialog). I am not sure what he did, as he asked the group and immediately got the answer from a fellow participant.
O7	One teacher asked me detailed questioning after the event about how to use the modelling tool to model a population of rabbits affected by birth rate, longevity, predation and availability of food. All of these would create separate formulae affecting the population size. I was not able to answer and am not sure how / whether the tool can support multiple formulae in this way.

Table 12. Interpretation notes

Note that these are pre-service teachers, and therefore their practical experience of classrooms is so far quite limited.
It should be noted that the tool was introduced as a prototype. Therefore the teachers felt quite free to criticise and make improvement suggestions.
Because the video was not played, **Questions 1, 2 & 3** were either ignored or the responses related to our ad hoc demonstration, which covered the material as the video but was not fully rehearsed.
Question 4: Most teachers understood the simple uses of the tool, but - as observation 7 shows - probably not many had considered more complex modelling.

Question 5: Many teachers were unsure whether their students would understand the purpose of the tool. Comments suggest it's suitable for older children, and a practically populated model, or one with more meaningful icons may be more useful for younger pupils.
Question 6 & 7: These questions generated roughly the same scores, indicating that the participants feel their own perception of the usefulness of the tool is reasonably representative of how they think other teachers will perceive the tool.
Question 8: Most participants did not think the tool was sufficiently easy to use. From observations and their comments, this could be mitigated by various changes such as: better names on the icons, perhaps customisable icons, make the arrow tool draggable like the other tools, easier facility to delete arrows, better help and tutorial facility, and clearer understanding of the purpose and scope of the tool.
Question 9 (the tool works well) seems to have got a range of responses, positive on average, but also - judging from the comments - seems to have been misinterpreted by several of the teachers. No significant bugs or faults were observed.
Question 10 and the **annotated diagrams** about what we should add, change or remove attracted a range of (sometimes conflicting) suggestions. The main themes were better online help and a tutorial, and better wording on the icons, or even different icons. Annotation A3 - specifically about unlabelled axes - is thematic with some critiques we have heard in the past from science teachers. In a previous event one teacher said that he wouldn't allow something in his classroom if it produced graphs with inadequately labelled axes.

The overall assessment derived from these results is presented in Section 7.1.1.

P. Detailed Results from PD Workshop with Students on the GoModel Tool (LEIC-03032017)

For the following results (Table 13, Table 14, Table 15, Table 16, Table 17, and Table 18) the PDot comment IDs are presented (either in brackets or in a separate table column) to enable the retrieval of the according original user feedback.

Positive comment regarding the video:

- Easy to follow instructions (2524)

Table 13. General findings

	Usability Observation	Recommended Modification	Related PDot IDs
1	Purpose of the tool is not very clear and explained.	Besides help on how to use the tool also add help on modelling options in the menu on the top (for cases where the video is not available).	2509
2	Concept of anonymous variables is not explained and their purpose is not clear.	Maybe a different icon then a cloud could be found for anonymous variables. Maybe no icon could be on the other end of arrows if the source or goal is anonymous.	2509
3	Mistakes cannot be reversed.	Undo (and redo) should be provided by the modelling tool, for example in the menu on the top.	2584, 2505

Positive comments:

- Starting the tool is simple (2507)
- The tool is easy to navigate (2507)
- The layout of the tool is clear (2507, 2504, 2517)
- Tool is very easy to use (2524, 2509, 2504, 2517)
- Tool is useful (2581)
- Automation support through modelling is perceived as positive (2522)

Table 14. Findings regarding menu on the top

	Usability Observation	Recommended Modification	Related PDot IDs
1	Rubber deletes whole model. There is no option to only delete single elements from the model.	Provide a button that changes the mouse cursor into a rubber, deleting each element on which the user clicks with it. Or explain the current functionality on how to delete variables and arrows.	2506

Table 15. Findings regarding menu on the left

	Usability Observation	Recommended Modification	Related PDot IDs
1	It is not intuitive how arrows can be added to the model. Some users try to drag arrow icon like they did with the variable icons.	Help or tooltip could be added to the arrow to explain the process of linking to variables. Alternatively and to be consistent to the other elements, arrows could be added by drag&drop as well, with an option to drag the ends of the arrow to the according variable, once it has been added to the modelling area.	2542, 2581, 2536, 2540
2	The label and meaning of "Aux" is not clear to users (without watching the video).	Help text and short description on mouseover could be added to support users in understanding auxiliary variables without having seen the video. Instead of the abbreviation "Aux" use the full name.	2547, 2508
3	Abbrevation "Const" is not understood.	Use "Constant" as label instead.	2511

Positive comments:

- It is perceived positively that the full name is used as the label for the "Stock" variable (2516)
- Drag&drop functionality for the variables is perceived as useful (2503)

Table 16. Findings regarding modelling (area)

	Usability Observation	Recommended Modification	Related PDot IDs
1	When drawing an error the user has to start exactly on the variable icon.	There should be a "leeway" area around the variable icons accepting arrows drawn from there as well.	2541
2	The modelling area could be too small for large models.	The user should be able to adjust the size of the modelling area if needed, e.g. by dragging on the edges.	2520
3	The arrows are created automatically by the tool (length and shape). Their visualisation cannot be influenced by the user.	The user could be enabled to manipulate the arrows in the model, e.g. to make them longer or bend differently and to move arrows around.	2530
4	Icons for "Stock" variables is perceived as boring and not intuitively understandable.	Users should be enabled to customize the icons, e.g. for the rabbit population a rabbit picture could be added to the square not only to make it more appealing but also to aid understanding of the model (relying less on reading the label). Explanation on why it is called a "Stock" variable and reasoning for a cloud symbol for anonymous	2501, 2527, 2559, 2575, 2519, 2502, 2510

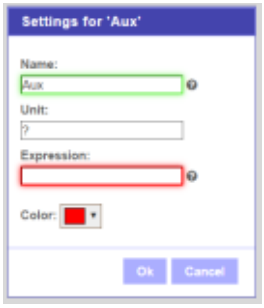
	Usability Observation	Recommended Modification	Related PDot IDs
		variables could be provided (maybe that is a task for outside the tool though).	
5	It is difficult and time-consuming to hit the "valve" when dragging an arrow to another one.	The user should be able to drop the new arrow anywhere on the old one, instead of having to aim for the valve symbol.	2570
6	It is not visible in the model when not all variables have been used in the Expression for an arrow.	Create a red highlight around the arrow (like is done for the textbox).	2523
7	The arrow leading from the Aux variable to the arrow between the two Stock variable does not properly line up with the valve.	Change visualisation algorithm so that the arrow hits the valve.	2546
8	The arrows between variables seem to be inaccurate when the model becomes complicated.	Start and end of each arrow should be more precisely linked to the variable they belong to, to avoid misunderstandings.	2537

Positive comments:

- Valve icon (looking like an "hour glass" for representing "time") is perceived positive (2533)
- It is perceived positively that the arrow connecting the Aux variable with the arrow between the two Stock variable moves when you move the Aux variable (2543)
- Arrow feature is perceived well (2539)

Table 17. Findings regarding popup to specify detailed information

	Usability Observation	Recommended Modification	Related PDot IDs
1	Initial value is not self-explanatory. 	This seems to be more an issue with modelling per se than with the modelling tool. Help could be added to explain the meaning.	2554, 2521

	Usability Observation	Recommended Modification	Related PDot IDs
2	Process to re-name variable is not intuitive.	Show a tooltip on mouseover indicating that the name can be changed by doubleclicking on the icon. Alternatively allow the name to be changed in the model (in place, like for examples for Windows folders in the Explorer, where you can click on the name to change it).	2507, 2515
3	Process to change variables is not intuitive.	Show a tooltip on mouseover indicating that the variable can be changed by doubleclicking on the icon.	2507, 2549, 2515
4	Instructions for "Expression" needed. 	Again this seems to be a general issue with modelling, the student would need to know what to put into the expression input field. This issue needs to be addressed outside the Modelling Tool (e.g. by the teacher, as part of the ILS which includes the tool). However help and a tooltip could be added to the dialog in the tool to support the user.	2551, 2512
5	OK and Cancel button look inactive.	The colour should be changed (e.g. to a darker purple, compare to active versus inactive tabs in the tab bar, to be consistent).	2557
6	Arrows and their meaning are unclear to the user.	Arrows could also have labels (like the variables; if this makes sense from a modelling perspective) or could show more information in a popup on mouseover.	2531
7	Colouring option for variables is not clear for the user (e.g. influence on the model?).	Help could be provided indicating if colour is only used as visual aid for the user or if there are conventions on how to colour-code specific (types of) variables.	2548
8	The meaning of "Unit" is not explained.	Unit could show a question mark like Name and explain what has to be entered there.	2521, 2512
9	It is not clear what it means to make a variable anonymous and which effect this might have on the model.	Provide help and or a tooltip for the "Anonymous" tickbox.	2532

Positive comments:

- Colour dropdown allows to change colour easily (2579)
- The option to make a variable anonymous is perceived as good (2529, 2535)
- Tick box to make variable anonymous is perceived as easy (2526)
- Arrows linking variables are easy to use and produce a clear link (2544)

- It is easy to create/add variables (2569, 2559)
- It is easy to understand what the variables represent (2569, 2515)
- Red frame around Expression when not all variables are used is perceived as useful (2523)

Table 18. Findings regarding the Graph tab

	Usability Observation	Recommended Modification	Related PDot IDs
1	User cannot change the graph title and axis labels (when printing).	Tool could allow the user to change the title and axis labels according to his or her needs.	2555, 2564, 2568
2	User cannot look at the model and the graph at the same time, which would allow them to see changes in the model immediately represented in the graph.	Add an option to open the graph in a separate window that can be shown side-by-side with the model.	2580
3	Tool only displays line graphs.	Options to display different types of graphs could be added.	2577

Positive comments:

- Graph functionality is perceived as useful (2528, 2556, 2562, 2561)
- Printing functionality is perceived well (2555, 2558, 2576)
- Export functionality is perceived well (2555, 2583, 2558, 2576)
- Visualisation as line graphs is perceived as clear (2574, 2566, 2571, 2562, 2561)
- Key is perceived as helpful (2578, 2572, 2565)
- Mouse-over feature showing values on the graph line is perceived well and useful (2582, 2573, 2560)
- Different colours for the different variables supports information extraction (2567)

The overall assessment derived from these results is presented in Section 7.1.1.

Q. Questionnaire Results from the PD Workshop with Students on the GoModel Tool (LEIC-03032017)

Table 19. Responses to the statement: "I found the video to be clear and understandable" (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

SD	D	N	A	SA	Comment
			1		n/a
			1		however could have written instructions of what each tool does when hovering over it as they are just shapes
			1		the video was clear to understand. Every step was explained thoroughly
				1	Very clear introduction with comprehensive language, the structure of content is clear and easy to understand
			1		it was spoken at a good pace and was explanatory at each step - it was clear what was being done.
			1		I agree that the video is clear as the video goes through every step to allow you to understand
				1	easy to understand while explaining everything
			1		very clear with an example which is easily followed
			1		it was very clear and understandable; this is because the speaker was well spoken
			1		the voice was clear and easy to understand as they were talking slowly. But some terminology in the video was hard to understand
			1		yes, explained all tools/features of the prototype clearly
			1		This video is clear and expands all the features and how they work and their outcomes are explained well, showing how to navigate the programme helpful video of information
			1		The video was a good pace and content was well explained with visual aid. Each point was thoroughly explained
				1	Each step to create a model was very clear; All the different functions are clearly illustrated on which menu explained; Language is clear and not too technical where instructions won't be understood.
		1			somebody in this expertise of the topic will more likely find the video understandable.
			1		n/a
0	**0**	**1**	**12**	**3**	**Total**

Table 20. Responses to the question: "Is the video an appropriate length?" (TS = Too short, LTS = A little too short, AR = About right, LTL = A little too long, TL = Too long)

TS	LTS	AR	LTL	TL	Comment
		1			it's long enough to explain everything in detail
			1		too long!
		1			the video was not too long or short. It did not drag on to makethe viewer bored
		1			10 minutes is enough for introducing a simple Modelling Tool with a complete explanation of functions.
		1			long enough to provide a sufficient account of detail; not tool ong you lose interest and it confuses you - get a good basic understanding
		1			the video was about the right length as it is long enough for you to understand what to do and not too long for you to lose interest
			1		too much time repeating information and some stuff is self explanatory which could be shown without an explanation like click and drag stuff
			1		slightly too ong started to get distracted at the 3-min mark
		1			I think it was about right because there was about enough information, so it was fine
		1			could be a little shorter, as they did drag on for a long time, a short summary and an example would have suffice. But it was a bit too long and a ot of explanation
			1		too much information given in-depth; it should be kept brief not just give an outline of the tool
		1			enough time to be able to understand/explain all the features on the programme and how these work, showing how to navigate this programme
		1			didn't need to be any longer after example of creation was finished, previously it was well explained.
		1			Each step is briefly explained with just enough information in order not to feel boring or time consuming; Barely any repetition on points so that a user won't become disinteresed
			1		certain features are explained longer than others
		1			n/a
0	**0**	**11**	**5**	**0**	**Total**

Table 21. Responses to the statement: "I understand the purpose of the Modelling Tool" (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

SD	D	N	A	SA	Comment
		1			n/a
			1		Its purpose is to model a scenario for example the growth of rabbits. The model could also be converted into a graph
		1			I understand how the model works; as it shows how it is down along with commentary instructions
			1		the function of the Modelling Tool was introduced. The purpose is cear - to build graphs by a easier way
			1		it is used to design models describing changing variables over time and looking at variables impact affecting that increase
	1				I don't fully understand the purpose. The video only explains what the tool does but not why.
			1		n/a
				1	with the video example it made the purpose of the modelling tool
			1		I think I would be able to use the model tool without anymore guidance.
			1		The modelling tool is very god it does what it's supposed to do and allows the user to add functions as well as graphs, different types of users can use it to make simple or more complex diagram.
		1			gives examples but not so clear on how it would be used.
	1				I am not sure of the prupose and why this programme would be needed, and this would be worked out elsewhere
			1		After the video, as a new user the purpose of the tool was clear to me, but a better understanding still requires first hand experience.
		1			every point fully expained is gone over is sufficient depth, but the constant tool is very weakly explained.
			1		n/a
			1		n/a
0	**2**	**4**	**9**	**1**	**Total**

Table 22. Responses to the statement: "The Modelling Tool could be useful for my learning" (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

SD	D	N	A	SA	Comment
			1		It could be used to explain relationships between variables
		1			it could help me make graphs and models but it is too confusing to use as I don't understand the anonymous cloud or shapes!
	1				I don't kmow how I would use it as too many of the same shapes made me confused.
				1	It's easy for me to build a graph I want which will be useful in some specific study
			1		it could be useful in designing models to explain certain increases and the factors affecting this.
1					not a very good learning tool as things are not explained I wouldn't use the tool.
	1				too and requires previous knowledge of interactions beforehand
			1		it is a good learning tool that can be used for graphics
		1			I may use it if I want to gather information if it was on a big scale for example thosands of people
		1			This could be useful for people trying to see how one variable affects the other so it could be used for planning stage
	1				I do not see how this tool would be used in CS (computer science)
	1				I don't think that its useful for my learning and I'm not sure if/when I would use it to aid my learning. Not very efficient or user friendly tool
		1			It is useful if there are clear instructions so the user can create a final model/graph - could be easier ways
			1		measure increase in target audience for a piece of software needing to be developed
				1	in a maths/science lesson after completing an analysis of an investigation
		1			to model different types of data using diagram and the graph
1	**4**	**5**	**4**	**2**	**Total**

Table 23. Responses to the statement: "The Modelling Tool could be useful for other students (university/secondary/primary)" (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

SD	D	N	A	SA	Comment
			1		I think primary/secondary school children may not understand how to use it. I think it would be most useful when used in schools to help students understand graphs/variables
		1			difficult to understand the meaning of the anonymous cloud and each shape. Also difficult to use.
		1			It would be useful when looking at population or growth
			1		The function of "variable", which gives students freedom to set equation and customise it based on their study of statistics
	1				I think it would be mainly useful at high secondary and university level because it would be quite complicated for younger years to use the concept of increasing factors
1					maybe in explaining new graphs works to children. But it will be hard for them to understand
			1		They may need to create graphs with many variables, hard to track lots of information and visualise it without any software
		1			it would be a useful if therew as a proper tutorial
		1			it would be useful if you want to find info quickly because it can be easily made
			1		It could be usefu survey (conducting) or maybe simplifying a query to see the effects it has on the chosen variables.
			1		maybe for mathematical/scientific modelling to forecast/predict
	1				It might be more useful in secondary school or university, however, I'm not sure in which context, maths or science would be the most useful one. Although I think other clearer programs would be a better tool.
			1		Perhaps secondary school - challenging but still easy enough to follow, would teach useful skills - need simple step by step guide
				1	physics - radioactive decay; biology - organisation population; economics - statistics and prediction on stocks
				1	when showing students the relationships made when drawing up graphs
		1			yes, you can use it to represent how many jobs there aer available to students studying at the university
1	**2**	**5**	**6**	**2**	**Total**

Table 24. Responses to the statement: "The Tool is easy to use" (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

SD	D	N	A	SA	Comment
	1				The help button could be used to explain, with simple steps, how to use the tool as it currently does not have any help available
1					too difficult! On screen instruction of what each shape and tool does And difference between each shpae
	1				change the shapes to make it less confusing. Also add in lables for what button is what.
				1	The 'undo' function I think. So far, people only can undo by drag the icon to tool bar, which can be promoted.
	1				the error message was not useful in pointing out where I had specifically gone wrong and was only a general message, making it hard for me to improve my model and make it functional
	1				make things clearer and add instructions
			1		biggest strength of the product, simplistic and not intimidating.
	1				add a tutorial on the system so that is easily make it
				1	I say put more information onto the buttons when you clicked them so you have more of an idea of what to use them for
			1		It is easy to use bu the different shapes need some explanation on the modelling tool as the user can forget what they are supposed to do.
		1			after watching the video - it seems as though the tool would be used differenty dependent on the context.
	1				there should be more inforamtion to be able to see how each feature/how the programme works, the programme isn't easy to use because the feature I don't understand to make it easier to use the features should be able to be explained, but not just on the video to make it more user friendly
		1			easy to use - when there is step by step introduction so the user knows what expression/units to input. Video instructions were useful.
		1			increase in clarity on what the functions do as there is no hep on how to use any parts of functions what so
		1			the format of text is overlapped by the shape of the drawing tool and the way the arrows are linked to the model elements are not formatted neatly
	1				should have information boxes to indicate what each symbol represents
1	**7**	**4**	**2**	**2**	**Total**

Table 25. Responses to the statement: "The Tool works well" (SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree)

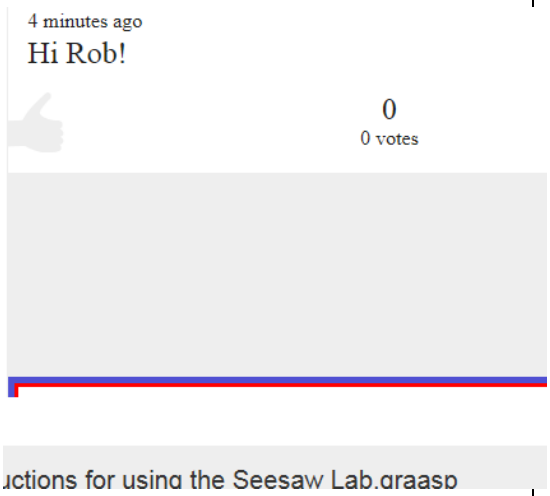
SD	D	N	A	SA	Comment
	1				The tool is inefficient as if you make a mistake you have to start from the beginning.
	1				Not clear on how to use it, unsure of different shape meanings could include this when hovering over each shape.
		1			The way the arrow works to link in variables, so that the user knows how to link them together. Also, it doesn't allow more than 2 links
			1		more tips for using.
		1			some bits were well, but it could do with more detailed explanation of what went wrong and how to use it efficiently.
		1			Add some pop-up messages when you do stuff you are not meant to.
			1		n/a
			1		with the knowledge how the tool works well and you could make it work
		1			the tool is up to speed, but it is annoying when the arrow doesn't go to where you want it to.
				1	It is simple and easy to understand with the graph as well all in one place.
		1			n/a
		1			even after watching the video a few times I am confused to the purpose of some of the features, and when I click on "?" feature no further information is shown, this could be improved to be able to understand each feature so they are explained well.
			1		It works well with correct data input - one wrong step and it does not work well - it's so simple and easy - when user has accurate data.
			1		all of the functions work well with no signs of any mistakes on the functions or tools available, however without being able to fully determine what they do, it is uncertain as to what they can do.
		1			the speed is good but it is mainly the drawing tools that need to be drawn neater.
	1				use of symbols can be more flexible.
0	**3**	**7**	**5**	**1**	**Total**

The overall assessment derived from these results is presented in Section 7.1.1.

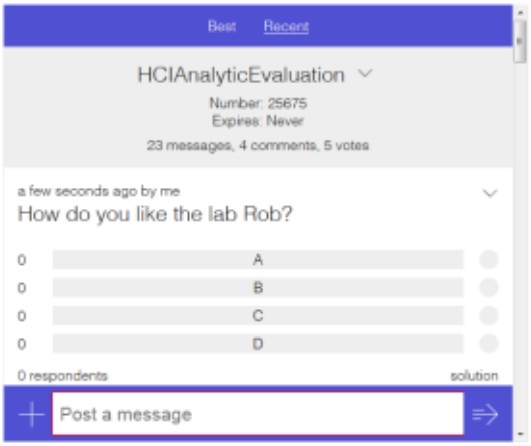
R. Detailed Findings on SpeakUp from the Analytical Study of the Seesaw Lab (LEIC-22062017b)

The following table lists the issues identified with the SpeakUp integration in the Seesaw Lab example ILSs (as an app to facilitate chats between two parties).

Table 26. List of usability observations of the SpeakUp app identified when evaluating the Seesaw Lab example ILSs

	Usability Observation	Recommended Modification	Import-ance
1	SpeakUp does not work in Internet Explorer (input box is nearly completely invisible and impossible to use). 	Make the SpaekUP app work properly in all major browsers.	**H**
2	There is a red border around the input box when it is empty (in Firefox), making it look like there is an error. 	Remove red border.	**L**
3	After sending a message the user has to click into the input box to type the next message.  Several times this caused confusion with the user starting to type the next message after sending one, only to realize halfway through the sentence, that the typed message did not appear in the input box.	After sending a message, the cursor should automatically reappear in the input box so that the user can continue chatting without having to manually click in the box again.	**M**

	Usability Observation	Recommended Modification	Import-ance
4	The chat puts the newest message on top, when “Recent” is selected as presentation option. From other chat apps users are used to having the messages in a chronological order from top to bottom, with the most recent one on the bottom. 	Add an option “Chronological” besides “Recent” and “Best” ordering the messages in chronological order from top to bottom and automatically scroll to the lowest message.	**L**
5	When scrolling down in the messages area, the user is not informed about new messages that appear on the top.	If the topmost message is currently not visible show an icon or a message informing the user about new, unread messages being available.	**H**
6	SpeakUp offers a lot of functionalities not needed for the chatting use case it is used for in the Seesaw ILS (e.g. voting interface allowing the user to like or dislike messages). This clutters the interface and takes up screen space, so that only a few lines of chat are visible at any given moment.	Offer a SpeakUp GUI that is optimized for chatting that is stripped of comments and voting.	**M**

	Usability Observation	Recommended Modification	Import-ance
7	When clicking on the +-button (which is only visible in Firefox, not in Google Chrome) a multiple choice question can be created (with default answer options A, B, C, and D that cannot be customized). This is inconsistent between browsers. 	Should at least be consistent between browsers. Functionality should be removed when not needed in the chat version of SpeakUp.	**L**

The overall assessment derived from these results is presented in Section 7.1.2.

S. Detailed Findings on SpeakUp from the End-user Evaluations of the Seesaw Lab (LEIC-27062017)

There is an urgent need to add notifications to new messages or to have the chat and lab at the same level on the screen.

Both groups struggled to communicate well enough in order to efficiently balance the seesaw together. They could only focus on the lab or the chat, but not keep track of both and work collaboratively on the same question.

Despite the confusion and problems to notice and retrieve messages from their partner caused by the commenting functionality, one team thought it had figured out a way how to take advantage of the commenting system throughout the course of working through the ILS (by questions 3): Their idea was to create a message with a question number and then perform the related discussion in the comments of this question. And although that sounded like a cunning plan, it did not work successfully in reality, because they somehow still ended up discussing in the comment thread of other messages or through messages in the end.

All participants expressed that after some time it gets difficult to keep track of who wrote what and were. They noted the indication on their messages labelled “by me”, but they believed it was not enough for them to identify their own messages. They would want to have different names or background colours for their own messages.

Table 27. Think-aloud comments and observations regarding the use of SpeakUp to facilitate the communication between two partners

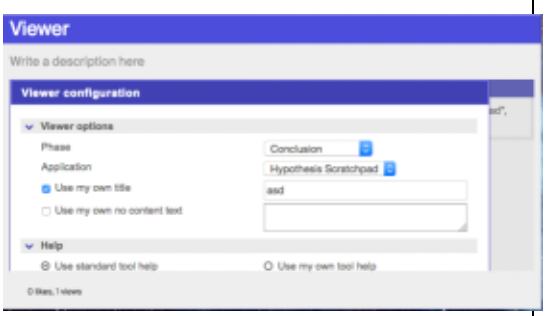
	Usability Observation	Recommended Modification	Import-ance
1	Participant is confused, which input field to use.	Remove the “create room” functionality, if it is the teacher’s task to create a room for their students and tell them the room number.	**L**
2	Voting system is unclear to participant: 1 vote for what? What is the meaning of voting? - It is not clear, what the voting system is for.	Provide a version of SpeakUp without voting for scenarios where the app is used for one-to-one communication.	**L**
3	Participant would like to see, which message was created by him.	“By me” is helpful but should be supported by different message colours. - There should be different colours for my messages, not only the text “by me”.	**M**
4	Difficulty to tell who wrote a specific message.	Should keep track of messages by clearly stating the user who created it, or having different colours to differentiate one from another.	**M**

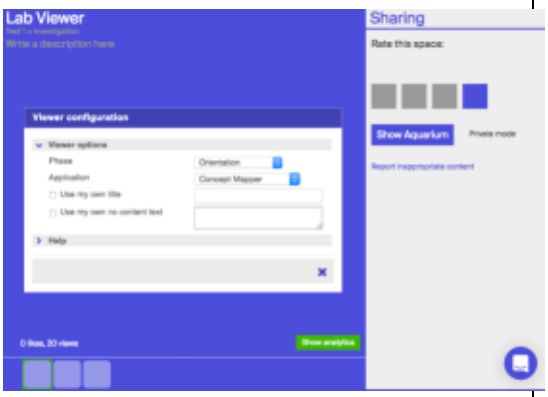
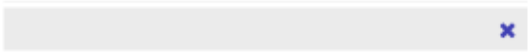
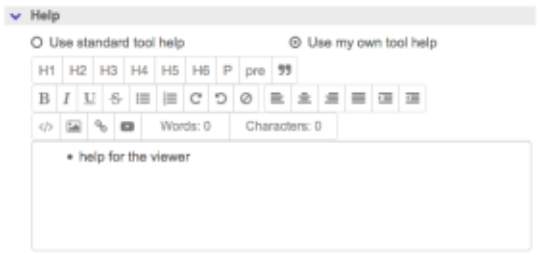
	Usability Observation	Recommended Modification	Import-ance
5	Communications can be lost if they happen in “Comments” of a message as there is no indication of new comments in the thread. If there are several messages with a comment thread each that can get confusing. - There are no indications for new comments, so the participant had to check all comment threads for each message to see if there were any new messages there. - Chat is confusing, because messages can be hidden in comment threads.	Besides the total number of comments to a message indicate the number of new comments.	**H**
6	New messages, comments and likes are either difficult to find or completely missed by the users.	There should be notifications for new activities inside the chat.	**H**
7	Users that comment a message stay there and do not realise there could be new messages at the main chatting screen.	Provide a version of SpeakUp without comments for scenarios where the app is used for one-to-one communication and/or add notifications.	**H**
8	Participant tried several times to continue typing after pressing enter and noticed later that he had to click into the input box with the mouse again to type the next message. - Participant continued typing after sending a message with enter. It took her a while to look up from the keyboard and realize that her input was not taken by the input box but she had to click into the input box with the mouse. (happened several times) - After pressing ‘enter’ to send a message, the user needs to click in the input box to type a new message.	After sending a message the cursor should stay in the message input box, so that the user can continue typing straight away. - After sending a message, the cursor should automatically reappear in the input box so that the user can continue chatting without having to manually click in the box again.	**M**
9	Participant accidentally created a poll. The partner could no longer send messages, as there was an “open poll”. Facilitator had to intervene and close the poll, so that both partners could communicate again. - Messages are not allowed to be sent after opening a poll.	Provide a version of SpeakUp without polls for scenarios where the app is used for one-to-one communication.	**H**

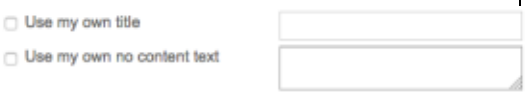
The overall assessment derived from these results is presented in Section 7.1.2.

T. Detailed Findings from the Analytical Walkthrough Performed for the Viewer App (LEIC-03072017)

From our observations and discussions regarding the usability of the new Viewer app, we were able to recommend some modifications that could boost its effectiveness:

	Usability Observation	Recommended Modification	Import-ance
1	The Go-Lab Viewer does not show the observation tool. --  --  	Verify that the Go-Lab viewer app works correctly with any app that it is required to.	**H**
2	It is not intuitive for the teacher to realise how to make the viewer hidden/shown (Set as hint). All other entries in the context menu influence Graasp, only “(Un)set as hint” influences how the element is displayed in the ILS.  	The option to hide/show the Go-Lab viewer app should be done within the configurations of the app instead. 	**M**
3	When the help is expanded, it hides the close button and it is difficult/impossible to scroll down.  	Make the configurations fit in screen size. Or, increase height of the area in which the pop-up window is shown for easier navigation.	**M**

	Usability Observation	Recommended Modification	Import-ance
4	The link to the aquarium is not necessary at all times when configuring apps. 	Remove unnecessary features while configuring apps.	**L**
5	Close button (x) can be misinterpreted as discarding changes rather than saving them. 	When hovering over the close button add 'All changes have automatically been saved' to the present message 'Close'. Or, change the image of a cross to a tick.	**L**
6	Too many options are distracting and can be confusing when writing own tool help. 	Drop unnecessary features.	**L**

	Usability Observation	Recommended Modification	Import-ance
7	Labelling of “hidden” viewer does not allow for identifying the apps inside the viewer. If more than one viewer is given within a phase, students may need to open all of them to know for example which is a previously formulated concept map or hypothesis. 	Show/hide label should include the (own) title set by the teacher, or the default viewer title (app name and phase) instead of the name given for the Go-Lab viewer in Graasp. Or, give the student the option to configure/select what app they want to view (e.g. instead of integrating several Go-Lab viewer apps, one for each app content they want to integrate in a later phase, the teacher can configure one viewer to show one of three app contents and the student can then select from these options).	**M**
8	It is unclear what title and text will be shown as default if teachers do not provide their own. 	Set the text from the student’s view as default on the corresponding input boxes and overwrite it when teachers want to customize it. Rephrase these configuration options for easier understanding.	**M**
9	Typos on the message shown to the student when the viewer is not working correctly. 	Should be rephrased to: “No application selected. Please ask your teacher to select an application in the configuration of the Go-Lab viewer.”	**L**
10	Sometimes the viewer does not refresh if a student makes changes to a concept map.	Make sure that updating is done seamlessly to the user.	**H**

The overall assessment derived from these results is presented in Section 7.1.3.

U. Questionnaire Results on LA Apps from Next-Lab Summer School 2017 (LEIC-11072017a)

The responses regarding the knowledge about and usage of the different LA apps are presented in the according Appendices below (Appendix V to GG).

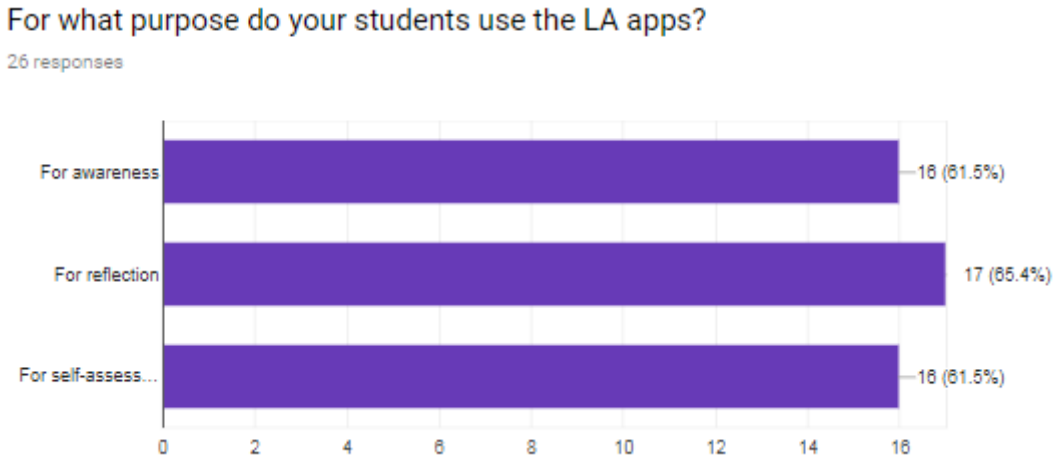


Figure 12. Purpose of LA apps for students (size of bar shows number of responders picking this option)

The answer option abbreviated in Figure 12 is: “For self-assessment”.

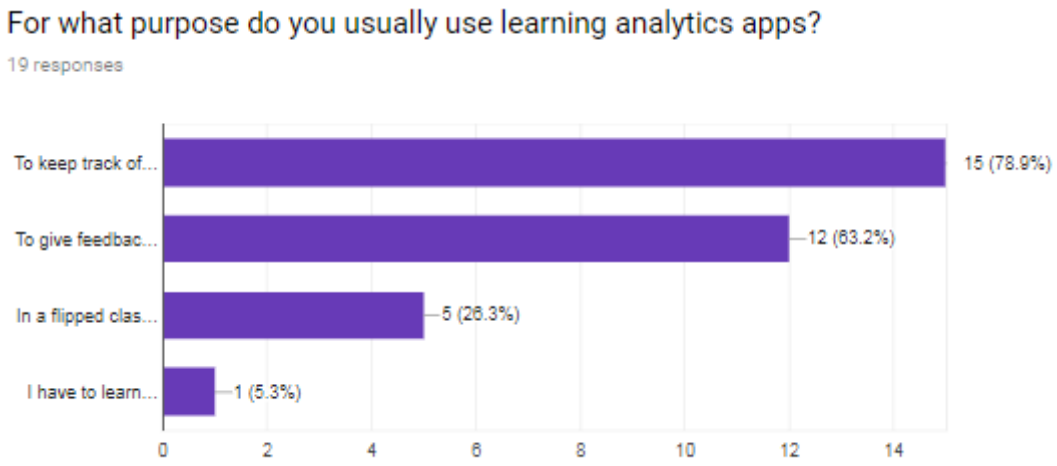


Figure 13. Purpose of LA apps for teachers (size of bar shows number of responders picking this option)

The answer options abbreviated in Figure 13 are:

- To keep track of students' progress
- To give feedback to my students
- In a flipped classroom
- I have to learn more.

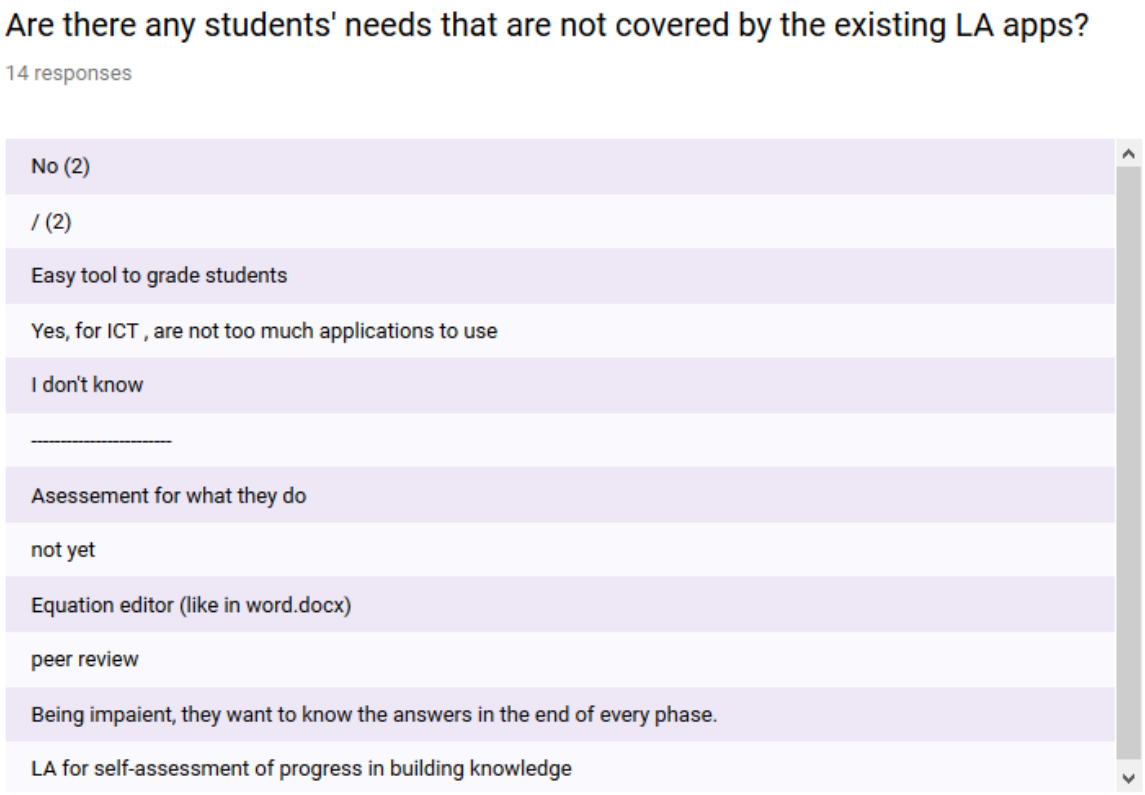


Figure 14. Responses to the question regarding students' needs not covered by LA apps

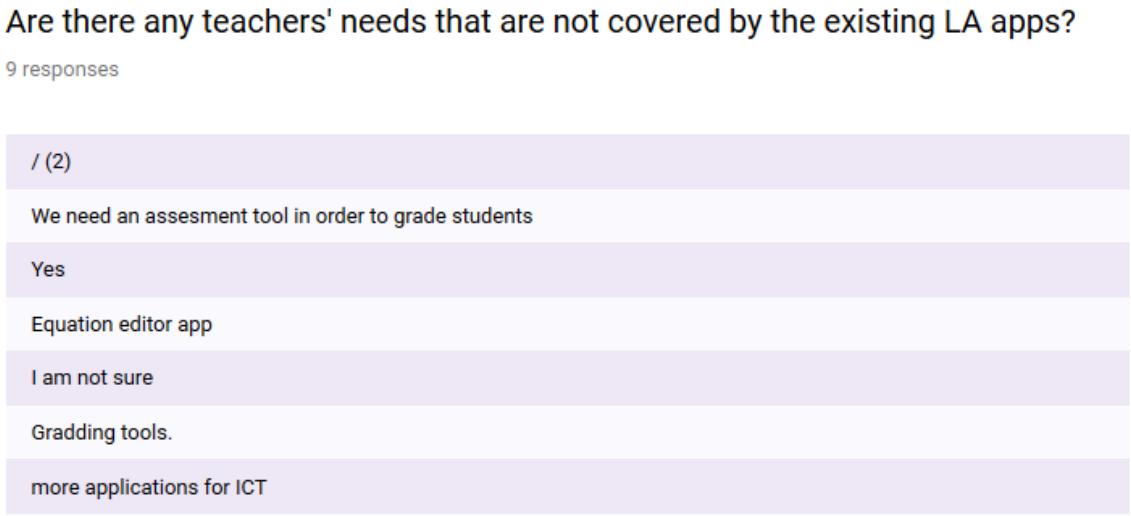


Figure 15. Responses to the question regarding teachers' needs not covered by LA apps

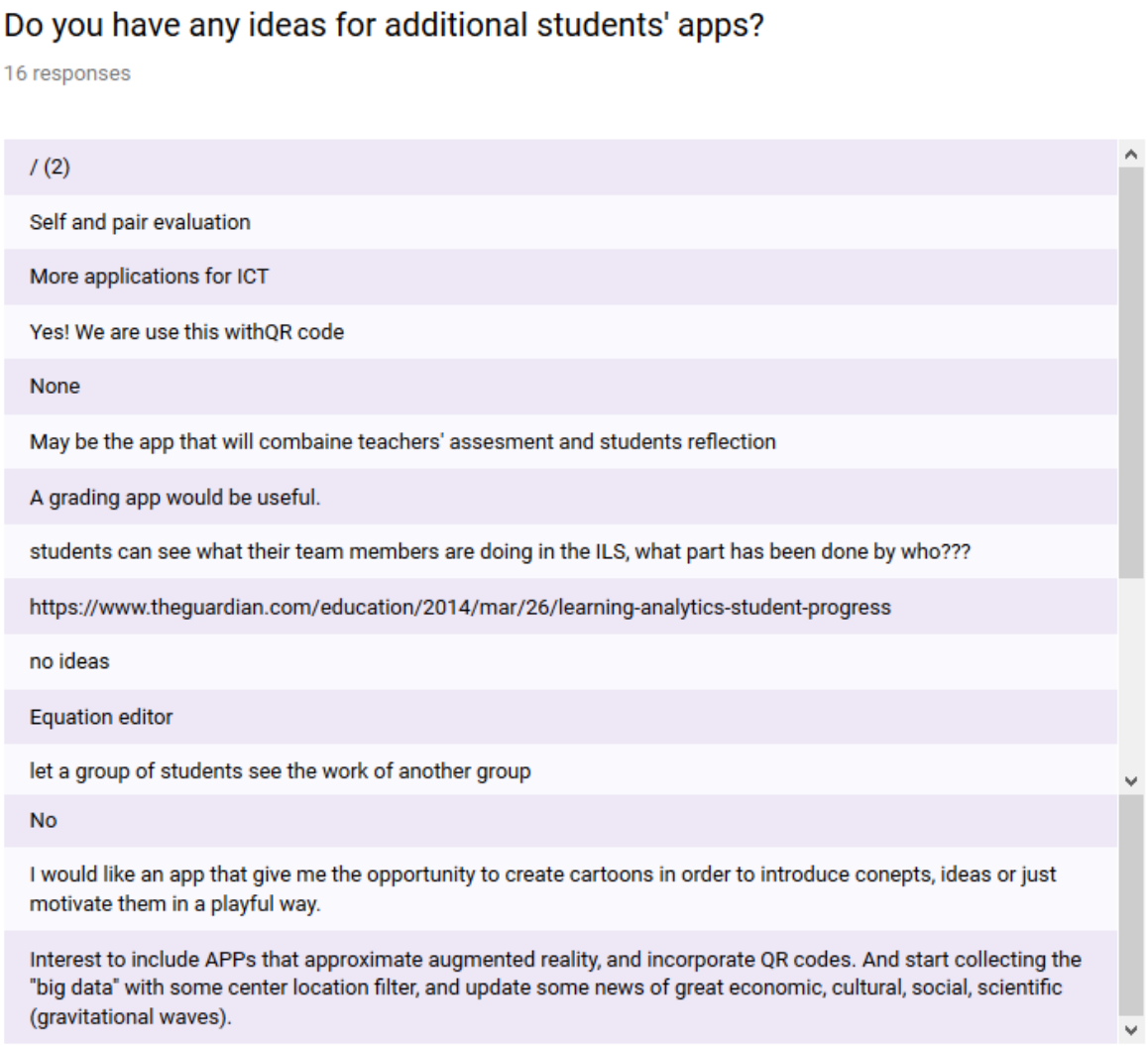


Figure 16. Responses to the question regarding ideas for additional LA apps for students

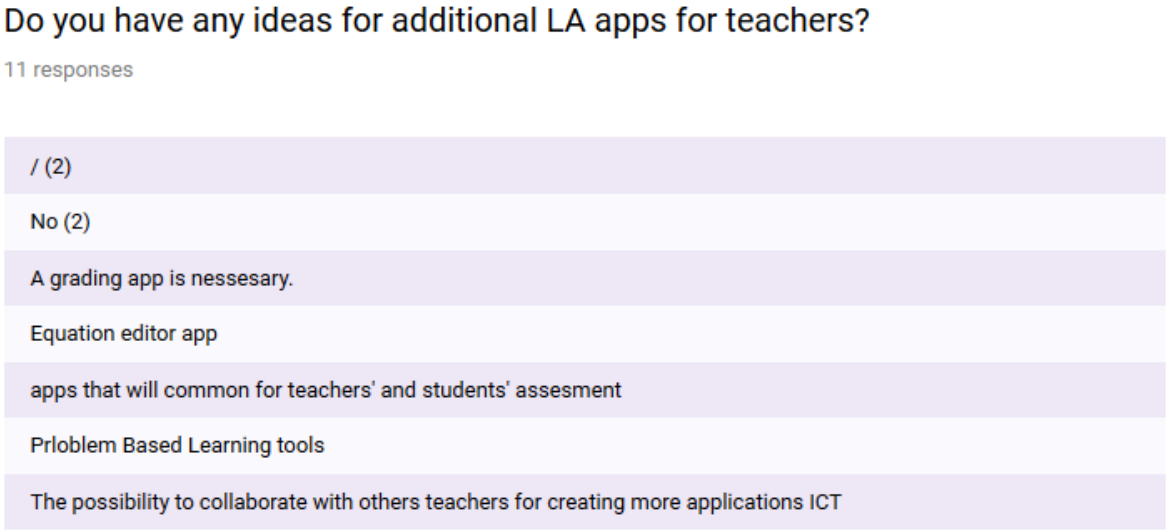


Figure 17. Responses to the question regarding ideas for additional LA apps for teachers

The overall assessment derived from these results is presented in Section 7.1.4.

V. Sticky Notes Responses to Action Statistics LA App

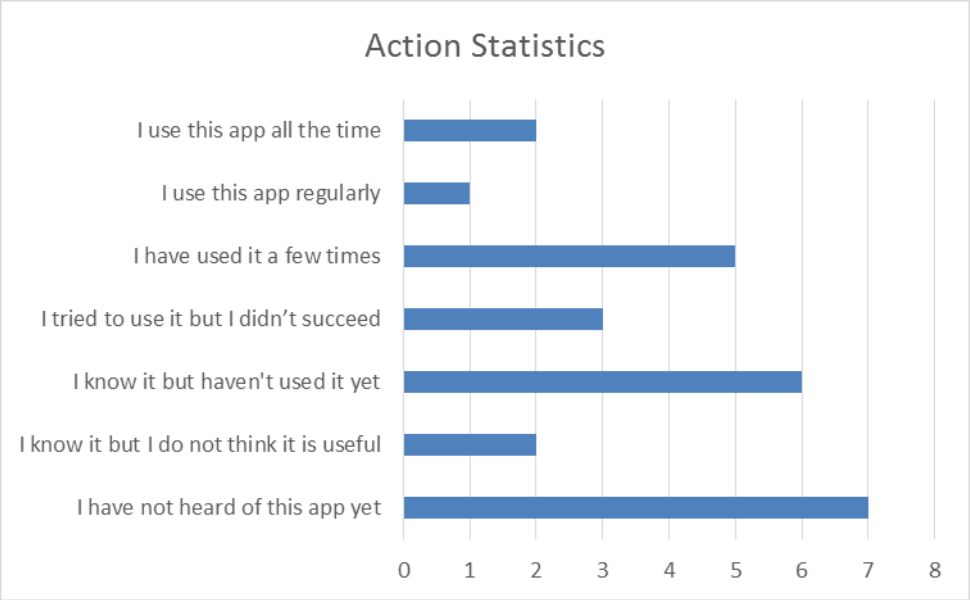


Figure 18. Responses to the question how frequently the participants have used the Action Statistics LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 3
  - Necessity
    3 ~> keep it
    usefull for teacher!
  - Usefull (teachers)
    4
    Students
    2
    X please
  - Not usefull for students only for teachers. ||
  - 5 for teachers
  - 5

- Suggestions (yellow sticky notes):
  - good to have a global information not for individual conclusion
  - It's great to have tools like this that are also design for students
  - Develop a tool that's mix this one with writing activitie of the student and ignore inactivity
- Negative comments (red sticky notes)
  - Does not give the right image of students work
  - ar the tables right!? It's not logic!
- Positive comments (green sticky notes)
  - Useful to better check how apps are used by students or if they get difficulties
  - Good
  - Cool!
  - Useful for teachers
  - Hole picture of student's work for teacher
  - Good for teacher and self-regulation

The overall assessment derived from these results is presented in Section 7.1.5.

W. Sticky Notes Responses to Concept Map Aggregation LA App

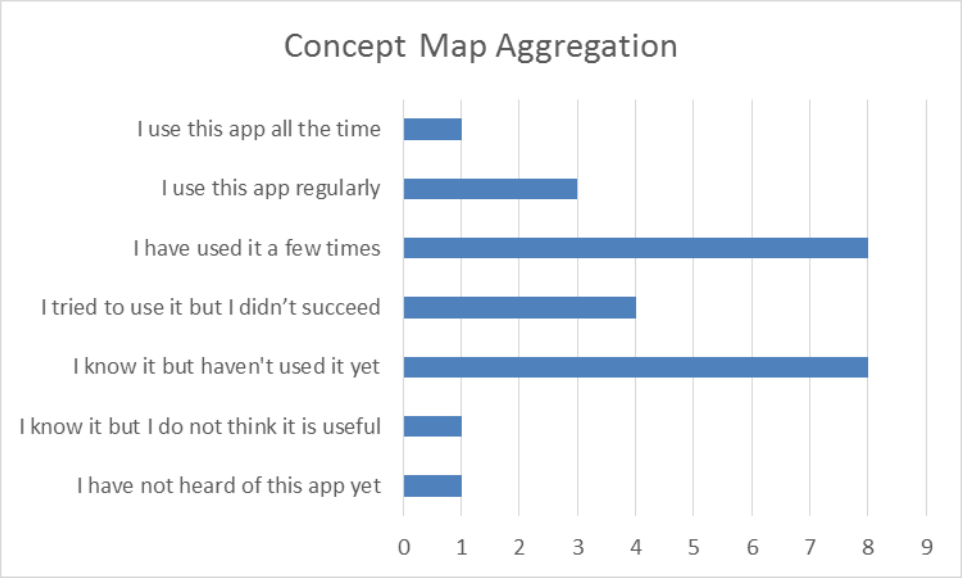


Figure 19. Responses to the question how frequently the participants have used the Concept Map Aggregation LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 3 but for high level students
  - 2
  - 2
  - | keep it!
  - 1 | will try it more
  - 1
  - 12 ??? details
  - Advanced students 3
- Suggestions (yellow sticky notes):
  - Move all the group of dots from the same user at the same time
- Negative comments (red sticky notes)
  - Very dependent on the design and other apps.
  - Problematic interface, if there are some things that close one to another, you can't see the difference
  - In primary school it's difficult to use

    - - Not that student friendly for lower secondary students
      - Time consuming
    - Confusing!
    - Difficult to use (both for teachers and students)
- Positive comments (green sticky notes)
    - Good app but with 25 students not easy
    - Very useful for teachers!
    - Excellent app to connect concepts together
      Need to be more user friendly

The overall assessment derived from these results is presented in Section 7.1.6.

X. Sticky Notes Responses to Concept Map Dashboard LA App

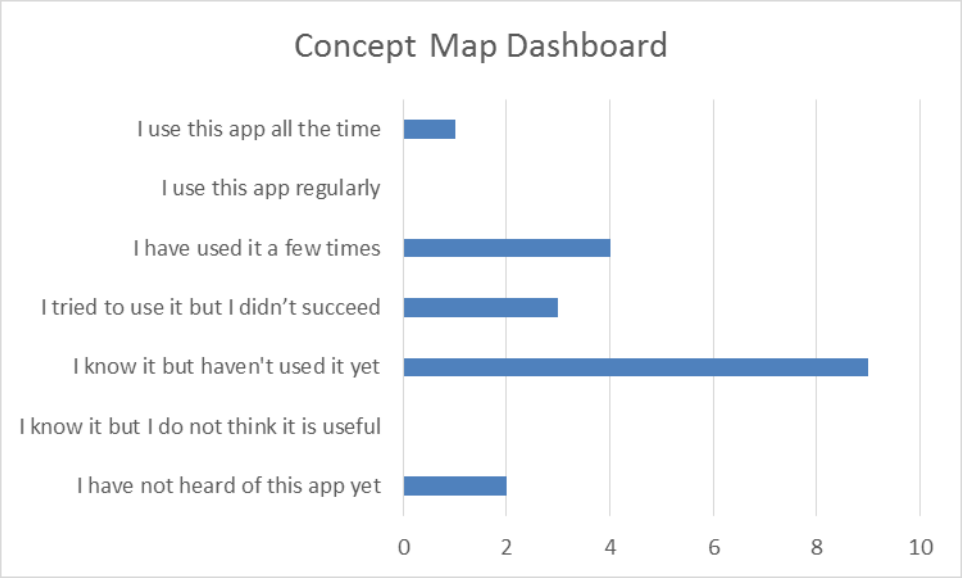


Figure 20. Responses to the question how frequently the participants have used the Concept Map Dashboard LA app (19 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors, words that could not be read are put in square brackets, e.g. [howler] and drawings added by the participants described in curly brackets, e.g. {drawing of a rectangle}):

- Necessity (orange sticky notes):
  - 4
  - 2
  - ???
  - ???
  - ??? !!
  - 2
  - Secondary education! Not primairy 1
- Suggestions (yellow sticky notes):
  - Turn it more easier for the teacher
- Negative comments (red sticky notes)
  - x
    I don't understand it
    ||

    - Low usefulness
      Not clear added value
    - Not very friendly
      needs more instructions [howler] to use it
    - Not easy to use {drawing of a rectangle}
- Positive comments (green sticky notes)
    - useful for teacher
    - -> Interactive
      -> the view is attractive

The overall assessment derived from these results is presented in Section 7.1.7.

Y. Sticky Notes Responses to ConceptCloud LA App

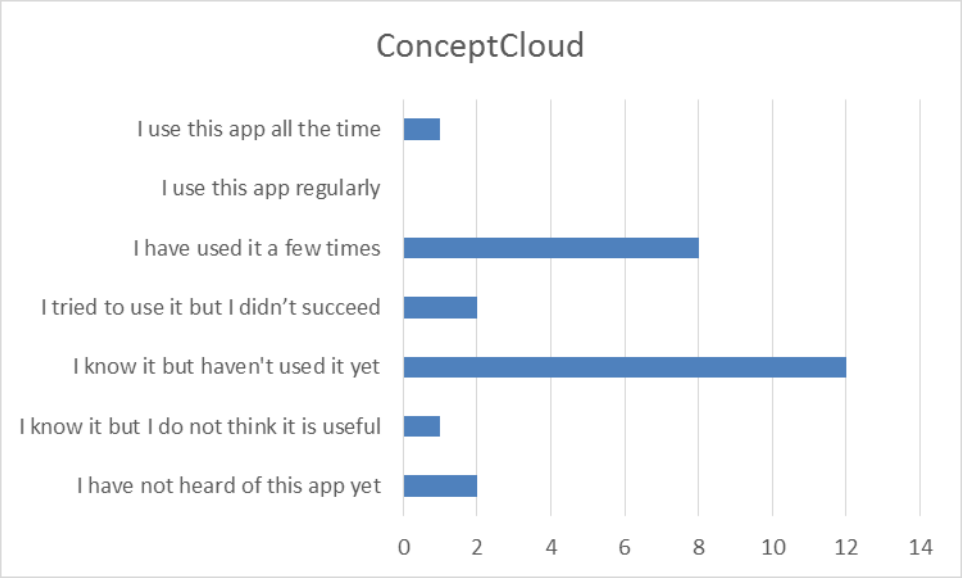


Figure 21. Responses to the question how frequently the participants have used the ConceptCloud LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 3
  - 2
  - 3 keep it
  - 4 I like it
  - 2
  - 2
  - 4 very good for reflection
- Suggestions (yellow sticky notes):
- Negative comments (red sticky notes)
  - –
  - confusing
- Positive comments (green sticky notes)
  - Very good and useful!

- Link all concepts in differents students & countries
  -
  concepts offer
- Nice to have in addition to concept maps
- It helps the teacher verify if the main concepts appear or it's necessary to intervene
- Students like it
- 2 e /
- Useful 12
- Good to see all concepts together

The overall assessment derived from these results is presented in Section 7.1.8.

Z. Sticky Notes Responses to Online Users Visualisation LA App

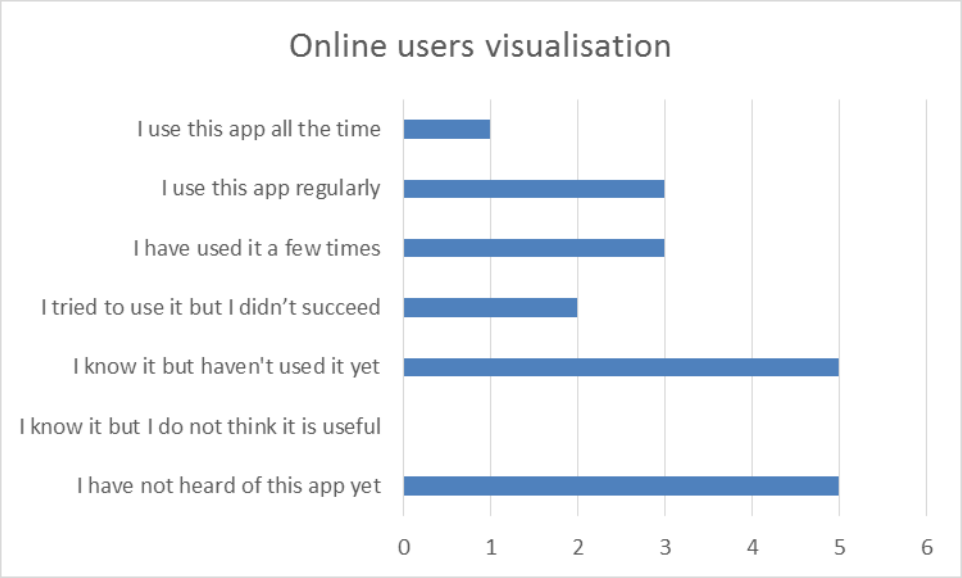


Figure 22. Responses to the question how frequently the participants have used the Online Users Visualisation LA app (19 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 4
  - For teachers and students 4
  - 4
  - 4 for teachers
  - 4
  - 4
  - 4
  - 4
- Suggestions (yellow sticky notes):
  - Improve the real time view
  - Visible only for teachers
- Negative comments (red sticky notes)
  - Potential distraction from the learning activity

- Positive comments (green sticky notes)
    - Very useful! (for teacher)
    - nice visualisation
    - - Useful
      - for teachers
      - Me to
    - 12 Useful
    - Opens the possibility for collaboration and communication with peers and teachers. (e.g. good in case of being troubles).
    - Allows students to have a feedback from each other in real time.

The overall assessment derived from these results is presented in Section 7.1.9.

AA. Sticky Notes Responses to Progress Bar LA App

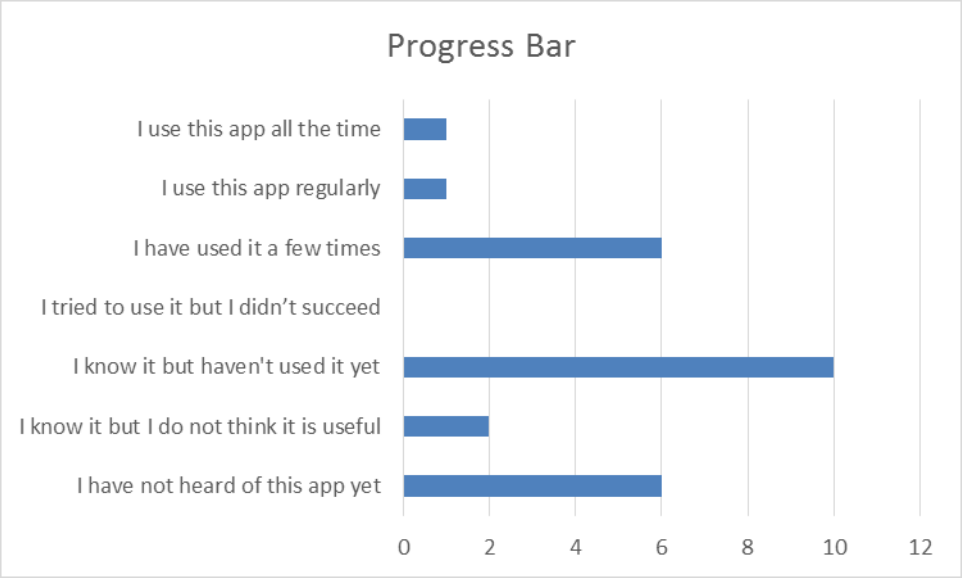


Figure 23. Responses to the question how frequently the participants have used the Progress Bar LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 4
  - 4
  - X
  - 4 +
  - 4
  - Improvement of evaluation
  - 4
  - 4
  - 4

- Suggestions (yellow sticky notes):
    - Implement a box with why? (Figure 24)

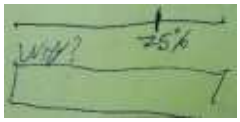


Figure 24. Drawing of an input box with the label "WHY?" underneath the progress bar showing 75% progress

- Negative comments (red sticky notes)
    - Excesive / Low self estime
    - Difficult for students to estimate their progress
- Positive comments (green sticky notes)
    - easy to use
    - useful 12
    - engaging app
    - Easily integrated in ILSs & student friendly
    - very useful
    - useful
    - very useful!
    - Good for self-awareness
      Being couscious about the learning process

The overall assessment derived from these results is presented in Section 7.1.10.

BB. Sticky Notes Responses to Reflection Tool LA App

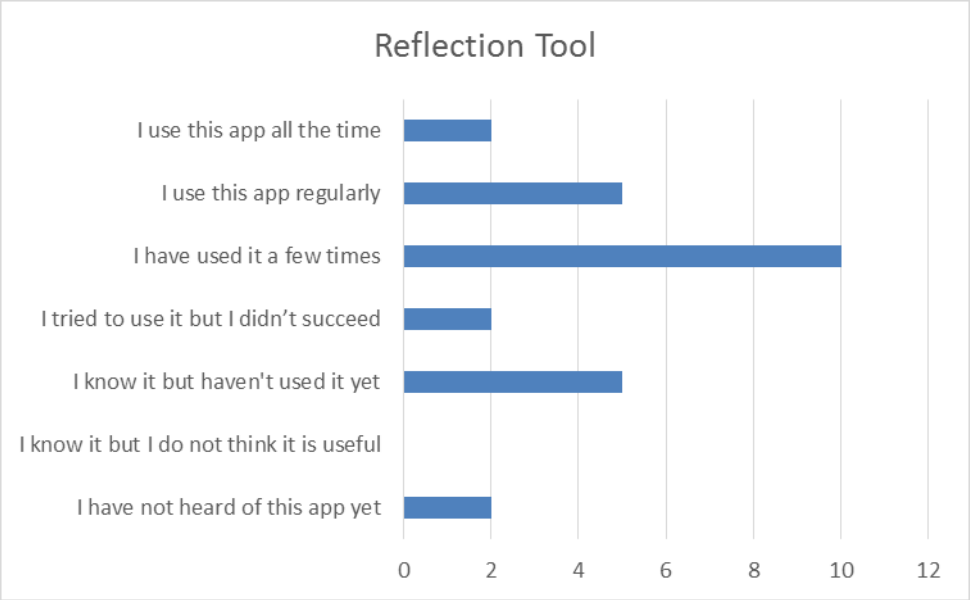


Figure 25. Responses to the question how frequently the participants have used the Reflection Tool LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - Very useful tool definitely a keep.
  - 3
  - 4
  - useful and friendly
  - 2
  - 4 useful for teachers/keep it
- Suggestions (yellow sticky notes):
  - A better reflection tool compared to then. 11
  - why 2 reflection tool! 1 is enough ||
- Negative comments (red sticky notes)
  - ?! No
  - not too meaningful for younger students

- Positive comments (green sticky notes)
    - Self-awareness about what are the main/less demanding parts so that they can self-regulate in the future
    - Useful 12
    - Practical for teachers at times
    - practical for feedback 4
    - useful for students and teachers give a good and faster way to give feedback to teacher
    - practical for the teacher 4
    - Older students can estimate their time in every phase which is helpful.

The overall assessment derived from these results is presented in Section 7.1.11.

CC. Sticky Notes Responses to Reflection Tool (Transitions) LA App

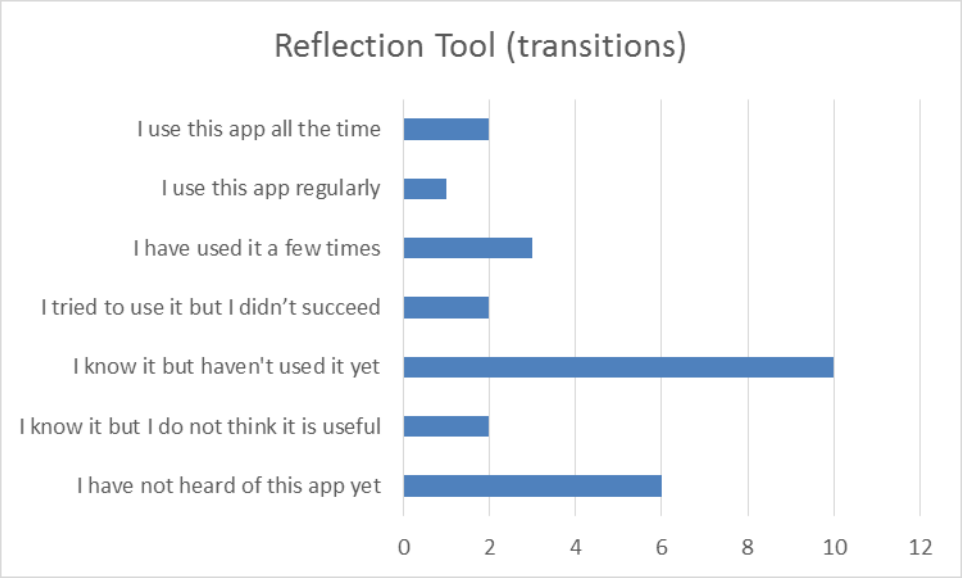


Figure 26. Responses to the question how frequently the participants have used the Reflection Tool (Transitions) LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 3
  - Useful for teachers
    3
    Not useful for students.
    2
  - 3
  - 2
  - 3
  - ???
  - Difficult for students 2
  - 12 ??? details
  - 3
  - 3 hard for students

- Suggestions (yellow sticky notes):
    - Why 2 reflection tools! 1 is enough
- Negative comments (red sticky notes)
    - Difficult for students
      Time consuming
    - Students don’t see it usefull.
      Students won’t take
    - It seems more suitable for teachers then for students
- Positive comments (green sticky notes)
    - It could be useful to understand students behavior in order to design better ILS
    - Useful for having a reference from the teacher’s expectations

The overall assessment derived from these results is presented in Section 7.1.12.

DD. Sticky Notes Responses to Semantic Group Formation LA App

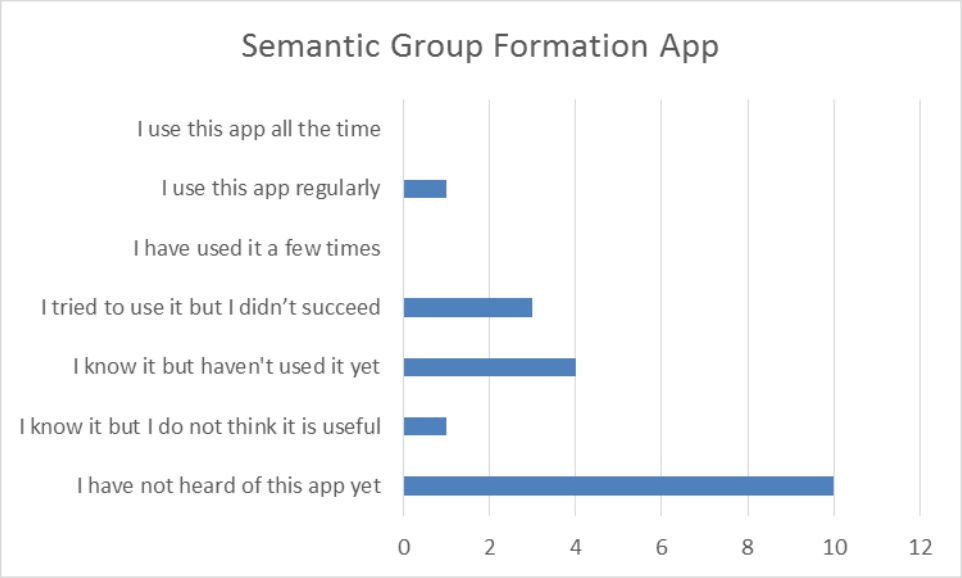


Figure 27. Responses to the question how frequently the participants have used the Semantic Group Formation LA app (19 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors. Parts of words that could not be read are presented in square brackets, e.g. classro[mnt]):

- Necessity (orange sticky notes):
  - 4
  - 1
  - X
    not needed as I know my students well.
    ||
  - 2
  - 4
  - ??
  - Is useful in classro[mnt]
    ???
    12

    - ?
    - X
    - 3
- Suggestions (yellow sticky notes):
- Negative comments (red sticky notes)
    - Low applicability
    - get ride of it!
      delete!
      Where are the datas from?
      ||
    - I work in groups
    - It is not useful for the younger students
- Positive comments (green sticky notes)
    - Cool!
    - Excellent idea!

The overall assessment derived from these results is presented in Section 7.1.13.

EE. Sticky Notes Responses to Student Time Spent LA App

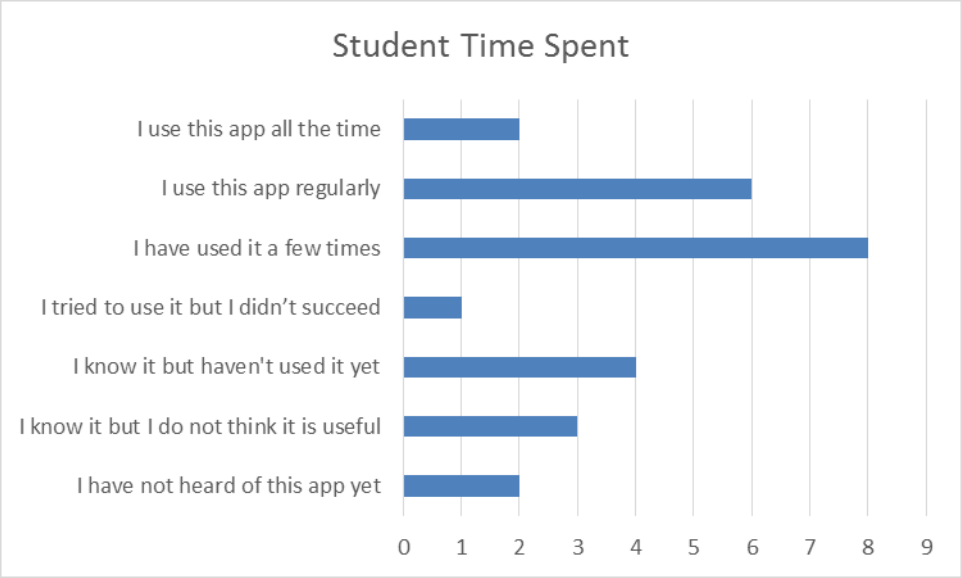


Figure 28. Responses to the question how frequently the participants have used the Student Time Spent LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 6 not just 5
  - X in the name of students
  - Great tool 5
  - 1
    For students
    3
    For teachers
  - 5
  - 5
  - 1 for students
    5 for teachers
  - 5 useful for teachers to monitor students
  - 5 keep it!

    - 5 for teachers
    - Let’s keep it
- Suggestions (yellow sticky notes):
    - Make it floating over the ILS in order to check in real time
    - Could be not real but interesting
    - Improve the connection problem
- Negative comments (red sticky notes)
    - If students take too much care of time spent they are less focused on learning contents
- Positive comments (green sticky notes)
    - Very efficient to control the students
    - - useful
      Useful to students to be aware of their organization
    - Useful
      well centured
      12

The overall assessment derived from these results is presented in Section 7.1.14.

FF. Sticky Notes Responses to Submitted Files in ILS LA App

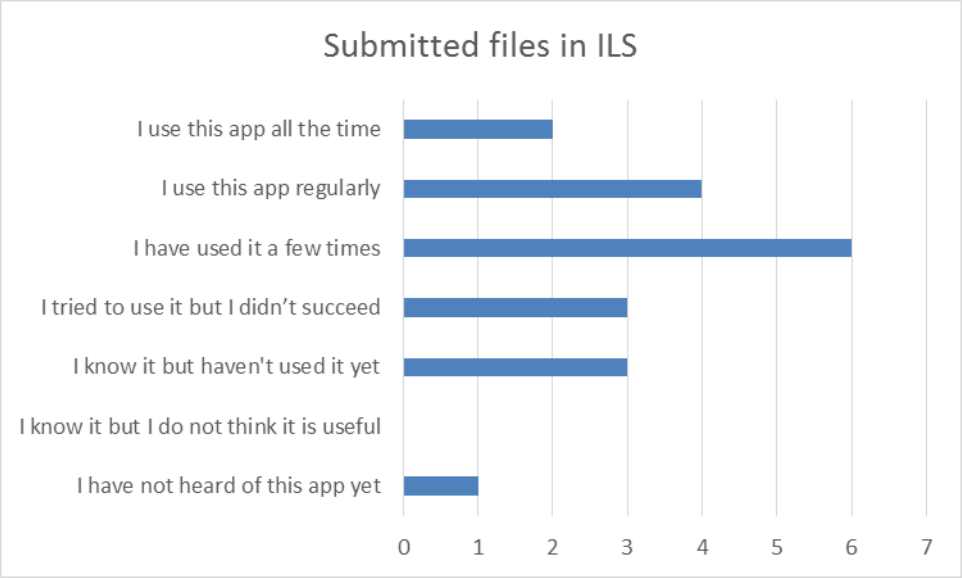


Figure 29. Responses to the question how frequently the participants have used the Submitted Files in ILS LA app (19 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 4 useful
  - Usefull 5
  - 5
  - usefull 5
  - 5 necessary
  - 5 useful
  - ???
- Suggestions (yellow sticky notes):
  - More friendly interface for user
- Negative comments (red sticky notes)
  - Need to be ILS specific
  - Mixed files if you have more than a filedrop in the ILS.

- Positive comments (green sticky notes)
    - Positive centured for teacher
    - gives the opportunity to use all the possible resources
    - Positive to make conclusions and evaluate students work
    - 5 Very good for monitoring

The overall assessment derived from these results is presented in Section 7.1.15.

GG. Sticky Notes Responses to Timeline LA App

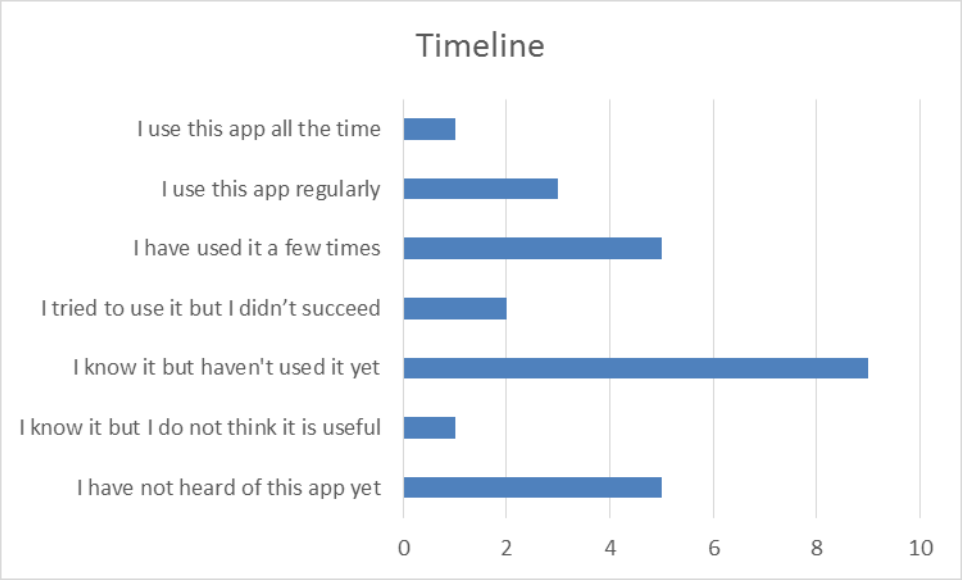


Figure 30. Responses to the question how frequently the participants have used the Timeline LA app (26 answers in total)

The teachers were asked to specify:

- The necessity of this app on an orange sticky note
  - ??? = I don't understand this LA app
  - X = Delete this LA app from the Go-Lab sharing platform
  - 1 - 5 = Keep this LA app
    (with usefulness being rated from 1 = a little bit useful to 5 = very useful)
- Suggestions on what could be changed in this LA app on a yellow sticky note
- Negative comments about the LA app on a red sticky note
- Positive comments about the LA app on a green sticky note

The sticky note responses of the teachers are transcribed below (without correcting typos and other errors):

- Necessity (orange sticky notes):
  - 5!
  - For teachers
    3
    For students
    2
  - 3
  - 3
  - 3
  - Keep it!
    4

    X please

    - 4
    - 5
    - 1
- Suggestions (yellow sticky notes):
    - No
      check ILS in real time
      Friendly interface
- Negative comments (red sticky notes)
    - The “show data from day” it’s a problem for me. It does not work everytime.
    - Not clear value for the students
    - No
- Positive comments (green sticky notes)
    - Useful for teacher to plan future ILSs
    - It’s very useful for students/tacher
    - 4 useful for teacher to plan and create future ILS
    - Useful for teachers to evaluate and design ILSs and have a view of how students work
    - Useful for homework
    - It’s useful 12
    - Mainly useful for the teacher

The overall assessment derived from these results is presented in Section 7.1.16.

HH. Detailed Findings on Seesaw Lab from the Analytical Study of the Seesaw Lab (LEIC-22062017b)

The entries in the following tables are presented in 'chronological' order of encountering them during the evaluation session (not sorted by Importance), to make it easier to follow the process and identify the position of the described issues in the process and on the websites.

Table 28. List of usability observations on the description of the Seesaw Lab on the Go-Lab sharing platform

	Usability Observation	Recommended Modification	Import-ance
1	There is a typo in the instructions.	"… where all the object**s** are …"	**L**
2	Some odd phrasings and grammatical errors in the instructions.	Check and improve the phrasing of the instructions. Examples: "The version called "Seesaw Lab - left side only" will *only* allow a user to interact with *only* the left side of the seesaw." (two times 'only') "…and click ~~again~~ the button "Create an Inquiry Space" **again**." "This will allow you ~~later~~ to access their chat transcripts **later** …"	**L**

Table 29. List of usability observations on the Seesaw Lab itself

	Usability Observation	Recommended Modification	Import-ance
1	You have to enter the room number twice, once in the chat SpeakUp app and once in the Seesaw Lab.	Seesaw Lab should take chat room number automatically from SpeakUp app.	**L**
2	The user has to scroll back and forth between chat SpeakUp app and the Seesaw Lab. Chat (messages) and Seesaw Lab are not visible at the same time, thus chat messages might be missed while interacting with the lab.	Chat should be included in the Seesaw Lab.	**H**
3	If several people sign on to the same side of a seesaw they can all control this side. It is automatically updated for the other people on the same side.	If the Seesaw Lab is intended for only two partners, there should be an error message "this seesaw is already full" when a person tries to sign in on a side of a seesaw that is already taken.	**H**
4	If one person "gets" a shared object a split-second after the other got it (while the square on his side is still green, because of Internet latency) the object blinks in both labs and the interaction becomes erratic.	The person who shared an object should not be able to reclaim it. If they want it back, they have to ask the other person to claim it and give it back.	**H**
5	If you re-join the same room, you see all objects for a short amount of time. If you share one that you are not supposed to have, it disappears from the other side lab.	Display the objects only after checking which ones should be available on this side of the lab.	**H**
6	Not seeing the other half of the seesaw fosters communication but could also lead to miscommunication. In the worst case that could lead to wrong answers/learning and marks deducted for students.	Let the teacher customize the Seesaw Lab to either show both sides or show a button once the seesaw is balanced, to reveal the other half of the seesaw.	**H**
7	Lab comes with a fixed set of weights.	There could be an option for the teacher to customize the available weights. Could also be different things to stacks of bricks (e.g. a dog, sack of potatoes, …).	**L**

The overall assessment derived from these results is presented in Section 7.2.

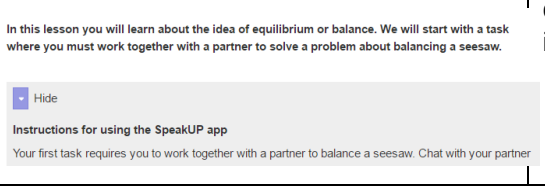
II. Detailed Findings on Seesaw Lab from the End-user Evaluations of the Seesaw Lab (LEIC-27062017)

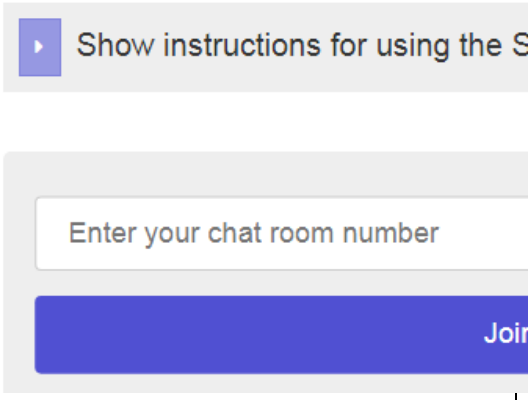
It is difficult to work collaboratively on the lab when participants do not know what is happening on the other side.

Left side: Participants did not see the point of inserting the Chat room number again in the Seesaw Lab; it should be taken from the chat automatically instead.

Right side is too passive. The contribution does not feel fair or equal as the user on the right side does not possess any objects to start experimenting with. Users end up feeling rather powerless or mere followers, at the same time that they believe they are not learning as much as their left side partner. Also, it was only clear that the right side was theirs because the seesaw started moving on the left side of the screen. Some instructions should be improved in both sides for the students to understand how to start experimenting with the seesaw. For example: to specify for students on the right side that their partner does not have any objects and that they need to send objects in order to answer the questions; or to tell participants on the right side to wait for their partners to send an object, or to give them some.

Table 30. Think-aloud comments and observations regarding the Seesaw Lab in the example ILSs

	Usability Observation	Recommended Modification	Import-ance
1	The hidden/collapsed instructions on how to use the seesaw lab were missed by the participant.	Make the instructions an integral part of the Seesaw Lab as help. Try to minimize instructions necessary, e.g. through phrasing of interface elements.	**H**
2	Instructions look repetitive for users at the start of the lab. 	Rephrase instructions to avoid repetition either on paragraph 1 or on the SpeakUp app instructions.	**L**

	Usability Observation	Recommended Modification	Import-ance
3	The message “Enter your chat room number” in the Seesaw Lab is confusing. The participant thought she already entered the chat room. 	Change message to “Your chat room number is also used to connect you with your partners side of the seesaw. Please enter it here.”	**M**
4	It is not clear for the person on the right hand side of the Seesaw Lab that they basically have to wait until the left hand side student shares objects with them.	Instructions should tell the person on the right hand side that they have to wait or better even, let students choose which side they want to be (with an explanation that right is active from the beginning and left has to wait for objects to be shared), so that they know what they are getting into.	**H**
5	For the right side of the seesaw, it is difficult to understand at the start how to get or share objects.	Change label on the box from ‘Drag-and-drop an object here to share it’ to ‘You are waiting for your partner to share objects with you’. Or give two objects to each participant.	**H**
6	Not very clear what side of the seesaw the student should be working on.	Instead of a dark colour, it would be better to have something more restrictive, like diagonal lines for instance. Or, having usernames on each side of the screen.	**L**
7	Green box (for new shared objects) is not enough to bring attention of users who do not realise there is a new object waiting for them to pick up.	Use notifications, sounds, or a brighter button for this purpose.	**M**

	Usability Observation	Recommended Modification	Import-ance
8	Participant was expecting sent objects to just appear in her object area and did not realize she has to press the green button to receive it.	Show sent objects directly without the need to “pull” them from the sharing box.	**M**
9	Participant tried to share a second object, while one was still “in the box”. - It is not possible to send more than one object at the time.	User wants to be able to share multiple objects at the same time. - Box should collect more than one object at the time.	**L**
10	Participants unsuccessfully tried to put more than one object on the same level of their side of the seesaw.	Stack objects or change new object for the one that was there before.	**L**
11	Participants cannot see the other side of the seesaw so some information is lost at times, or they need to go back to the chat to check what their partner did to balance the seesaw.	The visual aid of seeing the final result can increase chances of deeper learning. Show both sides of the seesaw when it’s balanced.	**H**
12	The participant was sometimes confused, how many objects the partner put on the other side of the seesaw, as there is no visual verification possible, but it has to be communicated through chat.	Participants understood that one of the goals of the setup is to foster communication of the partners through chat. However, it should be discussed, which improvements would be possible without violating the initial idea (e.g. show other side of the seesaw once it is balanced? Allow students to share screenshots of the lab in the SpeakUp chat?).	**H**

The overall assessment derived from these results is presented in Section 7.2.

JJ. Detailed Findings on ILS Design from the End-user Evaluations of the Seesaw Lab (LEIC-27062017)

It is currently hard to know if the other partner is online / active.

Right Side; Participant one: After accessing the room, the participant went straight away to the chat and started playing with the options available; he thought the like and dislike options were very useful to communicate emotions with the partner. Once he moved to the seesaw lab he noticed that objects were not available yet, but he thought these objects would appear when the other student joined the lab. After a few minutes of waiting, it created uncertainty; the participant did not know if the other student was around or not; he used the chat but still there was not an answer.

Right Side; Participant two: After accessing the room, the participant went straight to the seesaw and started clicking everywhere looking for objects to try and put on the seesaw. After realising she needed help from her partner, went to the chat and messaged a few times. Several minutes passed by and there was no reply, so she suggested that at that point she would have quit the task thinking that the partner on the other side was away or offline.

Table 31. Think-aloud comments and observations regarding the combination of SpeakUp chat and Seesaw Lab in the example ILSs

	Usability Observation	Recommended Modification	Import-ance
1	Waiting creates uncertainty. Students don't know if their partner is online until they receive a message or see the seesaw moving, which could take a long time in some cases.	Having an indicator (such as a green light) to show that a student is active in the other half of the Seesaw ILS.	**H**
2	Having to specify the room number twice (in SpeakUp and Seesaw Lab) is cumbersome.	Room number for Seesaw Lab should be automatically taken from SpeakUp.	**L**
3	It is very annoying that you have to scroll up and down constantly to switch between Seesaw Lab and SpeakUp chat. - Scrolling is very annoying. - Difficulty while moving between apps.	They should be side-by-side (very important!). - Chat and lab should be next to each other.	**H**
4	Sometimes the participant focussed on balancing the seesaw in the Seesaw Lab and did therefore not notice new chat messages in the SpeakUp app.	Participant would want to have notifications, informing him about incoming messages. - Chat should play a sound when new messages arrive.	**H**

	Usability Observation	Recommended Modification	Import-ance
5	Sometimes students were busy writing in the chat and no longer noticed what was happening in the Seesaw Lab (out of sight).	Seesaw Lab should make a sound when objects are shared, to make students aware that sharing happened when they are in the chat.	**H**

Table 32. Think-aloud comments and observations regarding the questions in the example ILS

	Usability Observation	Recommended Modification	Import-ance
1	It is not clear from the instructions of the lab that the partner cannot see the answers to the questions.	Make this clear in the instructions. Or even better, share the answer input boxes between the partners. This would also solve the issue of partners working on different answers and as they worked together to come up with the answer it would only make sense to also phrase them collaboratively.	**M**
2	There is only a textual description of the answer while the task was solved in the visual environment of the Seesaw Lab.	Answers to questions could be enhanced by showing a screenshot of the balanced scale next to the question.	**L**
3	“describe exactly how you made the seesaw balance.” was perceived as misleading. Participant thought it meant to describe what was discussed in the chat, not where which object was put in the end.	Rephrase instructions, e.g. “If yes, describe exactly which objects where in which positions on which side of the seesaw.”	**H**
4	Participant thought that 1 object meant “one object on my side”. - Users assume that questions and the use of objects are for them only, not as a group. Therefore, if the instruction says ‘balance the seesaw with two objects’ they use two on their side.	Rephrase question, e.g. “Can your team make the seesaw balance using only 1 object?”. - Rephrase the questions to make it clear for students that is 2-3-4 objects in total, not on each side.	**H**

	Usability Observation	Recommended Modification	Import-ance
5	The participant thought she balanced the seesaw “using only 1 object” (Q1), because she was not aware that her partner put the child (30kg) on 1 on the other side of the seesaw, when she put 10kg bricks on 3 on her side.	Reveal the other side of the seesaw once it is balanced.	**H**
6	The two participants got desynchronised with one still working on Q3 while the other already worked on Q4. It took them quite some time to figure that out via chat. - Participants were working on answering different questions without noticing, because participant on the left side saw the seesaw balanced at some point and thought that was the solution for Q3 and thus moved on to Q4 where participant on the right side of the seesaw did not notice that and continued working on Q3.	Participant would like a button next to each question saying “Done” to indicate to the partner, which of the questions they have already answered. - A possible solution that would work with the existing functionality would be to have one seesaw lab underneath each question. The participants can then make the seesaw balanced for a question and after writing down the answer move on to the next Seesaw Lab underneath the next questions. Users would then notice if the seesaw is not moving in this question, but in the one before, that the partner is working on a different question.	**H**
7	Users are not sure if they completed all tasks, or even if their answers have been saved.	Add buttons to specify ‘finish’ or ‘save’.	**H**

The overall assessment derived from these results is presented in Section 7.3.

KK. Details for CGT Task: Keywords (LEIC-00032017)

Table 33 presents the data collected using the online questionnaire with the Next-Lab core group and PD teachers.

Table 33. Responses to the keywords questionnaire (1 = Strongly Disagree, 2 = Somewhat Disagree, 3 = Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree, 8 = Not able to respond)

ID	Statement	1	2	3	4	5	6	7	8
S1	Keywords provided should always be displayed on the portal.						3	5	
S2	Keywords for Labs could be useful.				1		3	4	
S3	Keywords for apps could be useful.				1		2	5	
S4	Keywords for ILSs could be useful.					1	2	5	
S5	Please describe how and when (if at all) you would like to use keywords.	(see below for textual replies to this question)							
S6	Keywords should be usable for searching. (E.g. you click on a keyword and receive a list of tools which have this keyword)				1	1	1	5	
S7	If a search facility described above was provided, the results of a search should contain only entities of the same type (e.g. only Labs if you clicked on a keyword within a Lab, and not Apps or ILSs).	1			2	3		2	
S8	When an entity is added to the portal, the keywords used should be selected from a predefined list, so as not to allow free text input.	1			3	3			1
S9	Any general comments or questions	(see below for textual replies to this question)							

Besides the rating using the 7-point Likert scale, participants could also provide textual comments to each statement, which are listed below:

- S1: Keywords provided should always be displayed on the portal.
  - Agree:
    - Keywords are never exhaustive, but they help to give some general idea or simplified information about the resource. And I think that's quite useful (but not imperative)
    - It depends on how many keywords are provided and what is the intention of use for them, but in general yes, I agree that keywords should be displayed at most times to give context to (and help sorting) any particular entity.
  - Strongly Agree:
    - No point ino point in providing them if they are invisible

        - Users are always in a hurry and it helps them judge whether to look further into the app
        - No point in providing them if they're invisible
        - If a search, e.g. for a keyword, leads me to a page, I need to see why. If keywords are hidden and my search term is not included in any of the other information, I don't know what brought me here. It might have been an (invisible) keyword, or an error.
- S2: Keywords for Labs could be useful.
    - Neutral:
        - I think the existing search and filter options, e.g. by age and topic, are sufficient and cannot think of added benefit by the keywords, but there might be one. For example in the Experiment Design Tool (I know an app, not a lab, but the concept is the same) screenshot above "experiment" and "design" are on one hand very broad and arbitrary, thus not really defining the item, on the other hand they should already be covered, e.g. by the name of the app. "Dependent variable" and "independent variable" are additional information, which might be useful.
    - Strongly Agree:
        - I hope they'll be part of a database and speed up search (just use in next-lab "newton's law" key word and find your choice of experiments and activities...)
        - I think so. Not in every case, but of course they could give a more clear idea of the content (that sometimes is very clear, but not in every lab)
- S3: Keywords for apps could be useful.
    - Neutral:
        - I think the existing search and filter options, e.g. by age and topic, are sufficient and cannot think of added benefit by the keywords, but there might be one. For example in the Experiment Design Tool (I know an app, not a lab, but the concept is the same) screenshot above "experiment" and "design" are on one hand very broad and arbitrary, thus not really defining the item, on the other hand they should already be covered, e.g. by the name of the app. "Dependent variable" and "independent variable" are additional information, which might be useful.
    - Strongly Agree:
        - Teachers are usually in a hurry (and tired), so whatever helps them is welcome
- S4: Keywords for ILSs could be useful.
    - Somewhat Agree:
        - "I think the existing search and filter options, e.g. by age and topic, are sufficient and cannot think of added benefit by the keywords, but there might be one. For example in the Experiment Design Tool (I know an app, not a lab, but the concept is the same) screenshot above ""experiment"" and ""design"" are on one hand very broad and arbitrary, thus not really defining the item, on the other hand they should already be covered, e.g. by the name of the app. ""Dependent variable"" and ""independent variable"" are additional information, which might be useful.

For ILSs I see additional benefits in keywords over apps and labs, as they allow teachers to specify a focus of their lesson or define it in their terms (e.g. key stage X instead of age range for UK teachers). While apps and labs cover a broad area, ILSs usually have a specific topic or focus, does adding a keyword that is more specific than ""Physics"" > ""Astronomy"" could be helpful for other teachers to know what to expect from the ILS (e.g. ""velocity of a meteoroid hitting earth"")."

    - Strongly Agree:
        - Also if specified for age range
- S5: Please describe how and when (if at all) you would like to use keywords.
    - probably if all other means of searching and selection fail.
    - Keywords I never used because they do not have links. I use the "Used in these spaces" and "Similar Apps" in the end of the page.
    - To speed up search for a lab - eg: Coulomb's law or Gauss's theorem for electric fields
    - Well I can only add ILSs, not labs or apps. We already provide the subject (e.g. chemistry) but keywords could be useful to be more specific - e.g. "titrations" or "acidity" or "effervescence" or "solubility". This might help people find my ILS more quickly. Similarly with labs. I'm not very sure whether I'd use them for apps.
    - Keywords are usefull, when I access to the description page, in the same way the field "descrition" helps. On the other hand, the more common keywords are useful for searches. Of course, creative and inventive people can be a bit messy with keywords, but that’s not a big problem for me.
    - For added value besides the information and filter options already in place (but making sure to not duplicate them). For searching.
    - To search for an specific category or tool. To look for similar artefacts or topics. To help sharing my own contributions.
- S6: Keywords should be usable for searching. (E.g. you click on a keyword and receive a list of tools which have this keyword)
    - Somewhat Agree:
        - sounds useful, so long as the users provide meaningful keywords
    - Agree:
        - Though this might not be totally reliable - e.g. if someone mis-spelled a keyword, or if different people used different but synonymous terms for the same concept.
    - Strongly Agree:
        - As above: it would be sheer magic
        - I find keywords, like labels, are useful for searching. The use of clouds of keywords (something similar to wordle pictures, but with links) with size proportional to the number of results are great too.
        - Keywords might have to be "keyphrases" (more than one word). I think based on the (assumed) number of keywords having them in a list and clicking on them would not work very well, auto-complete when starting typing existing keywords might work better.
- S7: If a search facility described above was provided, the results of a search should contain only entities of the same type (e.g. only Labs if you clicked on a keyword within a Lab, and not Apps or ILSs).
    - Strongly Disagree:

        - Filtering for Lab/App/ILS should be separately from keywords, i.e. if a keyword is used in an app and an ILS searching for it should bring up both. Then there could be an additional filter option "Show only apps" / "Show labs and ILSs".
    - Neutral:
        - one at a time, they should be separate: alternatively, offer a choice of search: AND or exclusive OR
        - If possible, I would prefer to have both options: to restrict the search to labs, or ILS when I'm strictly looking for them, but being allowed to make a general search too. General searches are useful when you begin to prepare a topic.
    - Somewhat Agree:
        - Maybe the results should appear in 3 columns (one with labs, one with apps and the other with ILSs)
        - It would be good to let the user decide. Having this option customizable would not restrict the search between all artefacts if necessary, although sometimes users may want to reduce their search by looking within the same entity type.
    - Strongly Agree:
        - Most people know in advance whether they're looking for a lab or an app or an ILS. A jumble of responses is unuseful.
        - I wish all searches were like this. I never want a mix of labs, apps and ILSs in response to a search, and I can't imagine anyone else does either.
- S8: When an entity is added to the portal, the keywords used should be selected from a predefined list, so as not to allow free text input.
    - Not able to respond:
        - This is the weakness of a keywords approach. Free text cuold include typos or poorly chosen sysnonyms. But constraints are difficult to manage.
    - Strongly Disagree:
        - I think the topics that can be covered with predefined sets are already covered well. Keywords and keyphrases should be freely defined.
    - Neutral:
        - this depend on how you set the database, I suppose. The advantage of predefined list is "advertisement": we read about an awful lot of labs we didn't know were there. As a teacher I would welcome a list to choose from, I would revise the whole syllabus of Physics just by choosing an app, plus, I'd get information about existing apps.
        - I am unsure if it is better to have a predefined list of keywords or not. Certainly having one means better organization and easier search, but it could be the case that the topic is not really part of the list. Perhaps the user could suggest such addition?
    - Somewhat Agree:
        - Predefined list with one field that could allow free text input (like "other:_____")
        - This could be useful to avoid the problem with synonyms, but might stifle creativity and restrict freedom of expression. It might also be a problem for someone to maintain the lists.

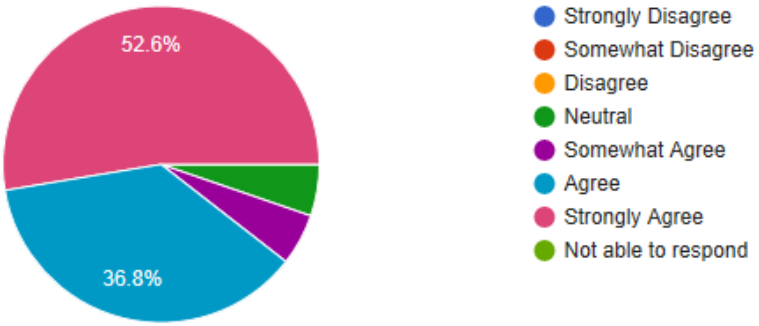
        - I think it's a bit more clear, even if I recognize I love inventing my own keywords... anyway, probably unuseful keywords will finish having really few occurences
- S9: Any general comments or questions
    - I think there are far more important things to fix in Go-Lab than this.
    - Great!!!
    - I think there are far more pressing things to fix in Go-Lab than this. The portal is already pretty easy to navigate.

The overall assessment derived from these results is presented in Section 7.4.1.

LL. Questionnaire Results on Keywords from the CGT Task: Keywords (LEIC-00032017) and Ambassadors Workshop in Brussels (LEIC-06052017b)

A. Keywords provided should always be displayed on the portal.

19 responses



No point ino point in providing them if they are invisible
Users are always in a hurry and it helps them judge whether to look further into the app
No point in providing them if they're invisible
Keywords are never exhaustive, but they help to give some general idea or simplified information about the resource. And I think that's quite useful (but not imperative)
If a search, e.g. for a keyword, leads me to a page, I need to see why. If keywords are hidden and my search term is not included in any of the other information, I don't know what brought me here. It might have been an (invisible) keyword, or an error.
It depends on how many keywords are provided and what is the intention of use for them, but in general yes, I agree that keywords should be displayed at most times to give context to (and help sorting) any particular entity.
It's very necessary, to find easier
Knowing in advance in which language it is available can be useful

Figure 31. Responses to the statement "Keywords provided should always be displayed on the portal."

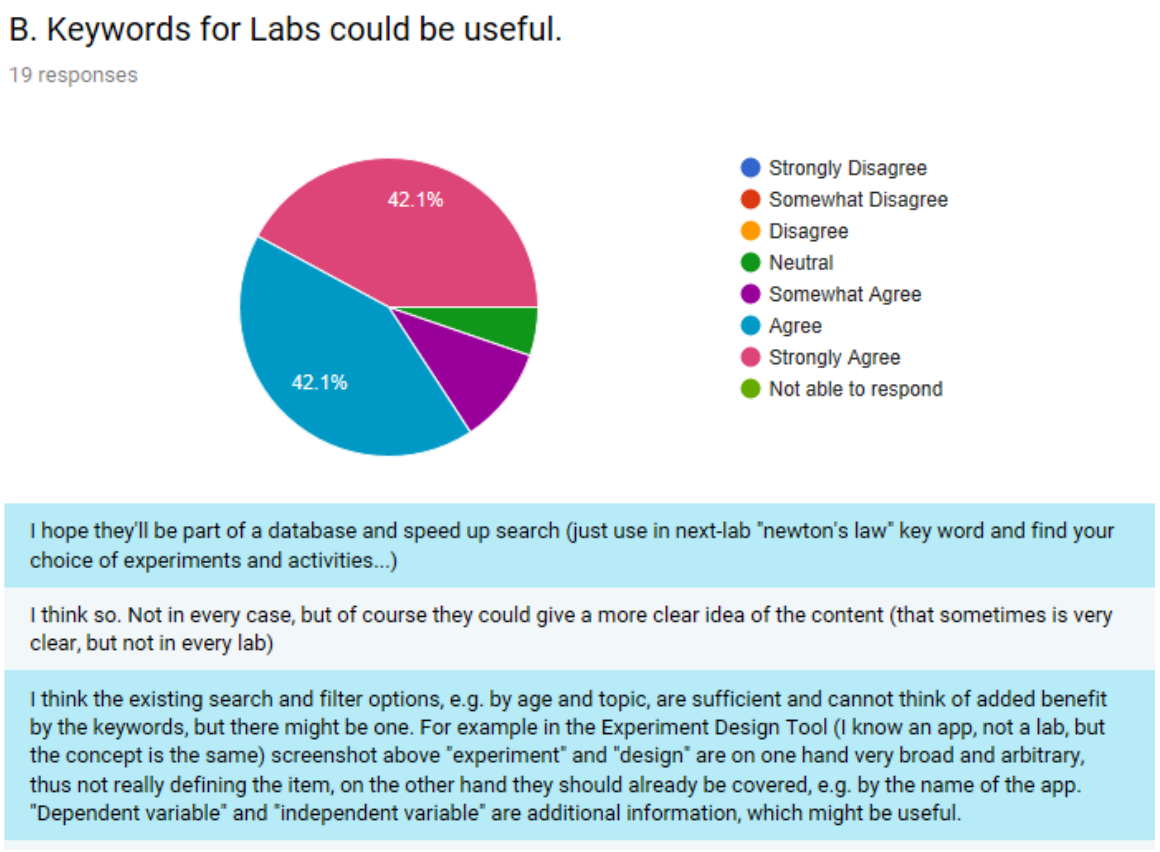


Figure 32. Responses to the statement "Keywords for Labs could be useful."

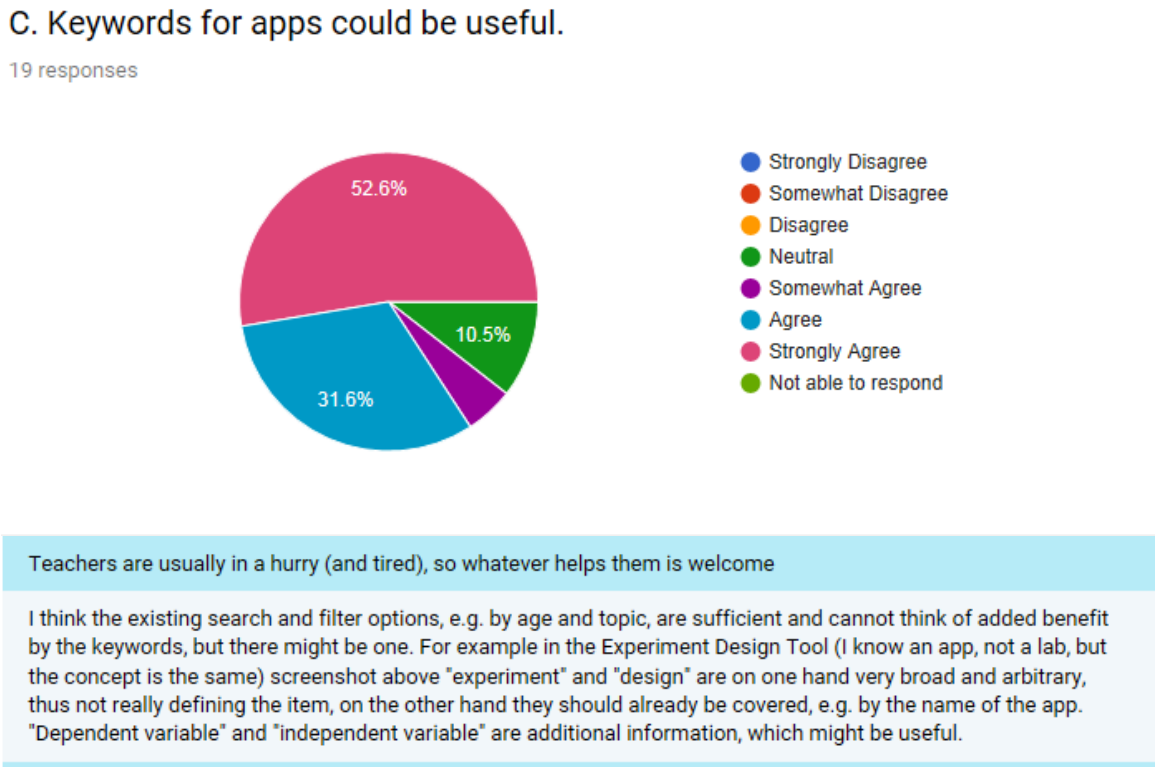
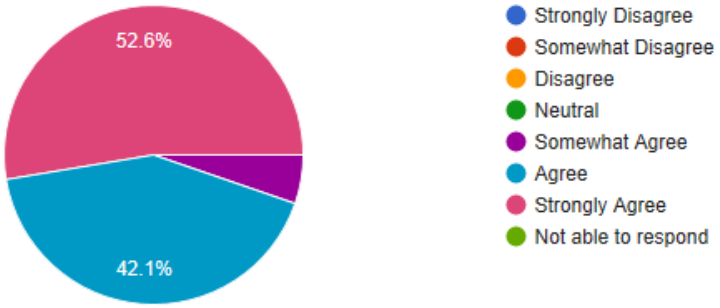


Figure 33. Responses to the statement "Keywords for apps could be useful."

D. Keywords for ILSs could be useful.

19 responses



Also if specified for age range

I think the existing search and filter options, e.g. by age and topic, are sufficient and cannot think of added benefit by the keywords, but there might be one. For example in the Experiment Design Tool (I know an app, not a lab, but the concept is the same) screenshot above "experiment" and "design" are on one hand very broad and arbitrary, thus not really defining the item, on the other hand they should already be covered, e.g. by the name of the app. "Dependent variable" and "independent variable" are additional information, which might be useful.

For ILSs I see additional benefits in keywords over apps and labs, as they allow teachers to specify a focus of their lesson or define it in their terms (e.g. key stage X instead of age range for UK teachers). While apps and labs cover a broad area, ILSs usually have a specific topic or focus, does adding a keyword that is more specific than "Physics" > "Astronomy" could be helpful for other teachers to know what to expect from the ILS (e.g. "velocity of a meteoroid hitting earth").

Figure 34. Responses to the statement "Keywords for ILSs could be useful."

E. Please describe how and when (if at all) you would like to use keywords.

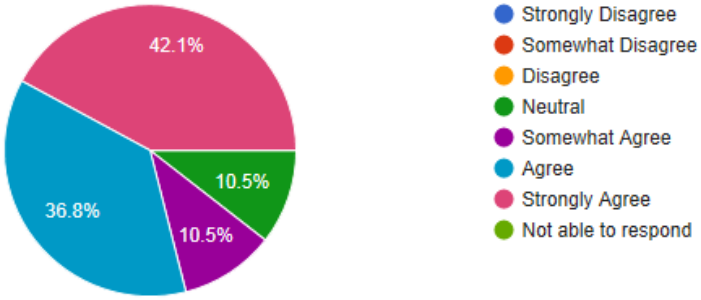
14 responses

probably if all other means of searching and selection fail.
Keywords I never used because they do not have links. I use the "Used in these spaces" and "Similar Apps" in the end of the page.
To speed up search for a lab - eg: Coulomb's law or Gauss's theorem for electric fields
Well I can only add ILSs, not labs or apps. We already provide the subject (e.g. chemistry) but keywords could be useful to be more specific - e.g. "titrations" or "acidity" or "effervescence" or "solubility". This might help people find my ILS more quickly. Similarly with labs. I'm not very sure whether I'd use them for apps.
Keywords are usefull, when I access to the description page, in the same way the field "descrition" helps. On the other hand, the more common keywords are useful for searches. Of course, creative and inventive people can be a bit messy with keywords, but that's not a big problem for me.
For added value besides the information and filter options already in place (but making sure to not duplicate them). For searching.
To search for an specific category or tool. To look for similar artefacts or topics. To help sharing my own contributions.
For lesson planning
For making quick search.
To search for labs, to narrow down the search
Knowing the language and school level
for ILS in order to find ILS
/
If i look for something special in a short time, it really can help

Figure 35. Responses to the statement "Please describe how and when (if at all) you would like to use keywords."

F. Keywords should be usable for searching. (E.g. you click on a keyword and receive a list of tools which have this keyword)

19 responses

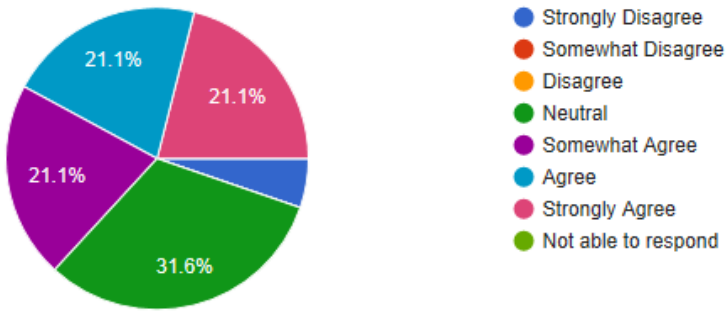


sounds useful, so long as the users provide meaningful keywords
As above: it would be sheer magic
Though this might not be totally reliable - e.g. if someone mis-spelled a keyword, or if different people used different but synonymous terms for the same concept.
I find keywords, like labels, are useful for searching. The use of clouds of keywords (something similar to wordle pictures, but with links) with size proportional to the number of results are great too.
Keywords might have to be "keyphrases" (more than one word). I think based on the (assumed) number of keywords having them in a list and clicking on them would not work very well, auto-complete when starting typing existing keywords might work better.
Knowing the simulation or remote lab included
/
Thats a great idea!!!

Figure 36. Responses to the statement "Keywords should be usable for searching."

G . If a search facility described above was provided, the results of a search should contain only entities of the same type (e.g. only Labs if you clicked on a keyword within a Lab, and not Apps or ILSs).

19 responses

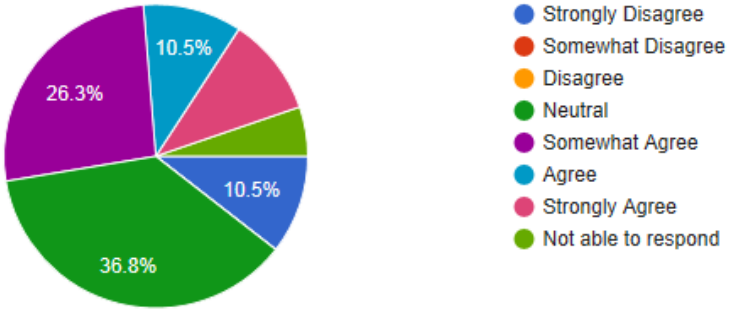


Most people know in advance whether they're looking for a lab or an app or an ILS. A jumble of responses is unuseful.
Maybe the results should appear in 3 columns (one with labs, one with apps and the other with ILSs)
one at a time, they should be separate: alternatively, offer a choice of search: AND or exclusive OR
I wish all searches were like this. I never want a mix of labs, apps and ILSs in response to a search, and I can't imagine anyone else does either.
If possible, I would prefer to have both options: to restrict the search to labs, or ILS when I'm strictly looking for them, but being allowed to make a general search too. General searches are useful when you begin to prepare a topic.
Filtering for Lab/App/ILS should be separately from keywords, i.e. if a keyword is used in an app and an ILS searching for it should bring up both. Then there could be an additional filter option "Show only apps" / "Show labs and ILSs".
It would be good to let the user decide. Having this option customizable would not restrict the search between all artefacts if necessary, although sometimes users may want to reduce their search by looking within the same entity type.
there can be ILS with Lab that Im looking for....

Figure 37. Responses to the statement "If a search facility described above was provided, the results of a search should contain only entities of the same type."

H. When an entity is added to the portal, the keywords used should be selected from a predefined list, so as not to allow free text input.

19 responses



This is the weakness of a keywords approach. Free text cuold include typos or poorly chosen sysnonyms. But constraints are difficult to manage.

Predefined list with one field that could allow free text input (like "other:_____")

this depend on how you set the database, I suppose. The advantage of predefined list is "advertisement": we read about an awful lot of labs we didn't know were there. As a teacher I would welcome a list to choose from, I would revise the whole syllabus of Physics just by choosing an app, plus, I'd get information about existing apps.

This could be useful to avoid the problem with synonyms, but might stifle creativity and restrict freedom of expression. It might also be a problem for someone to maintain the lists.

I think it's a bit more clear, even if I recognize I love inventing my own keywords... anyway, probably unuseful keywords will finish having really few occurences

I think the topics that can be covered with predefined sets are already covered well. Keywords and keyphrases should be freely defined.

I am unsure if it is better to have a predefined list of keywords or not. Certainly having one means better organization and easier search, but it could be the case that the topic is not really part of the list. Perhaps the user could suggest such addition?

For ILS using simulations or remote labs, the names of these and their url should be entered manually

Figure 38. Responses to the statement "When an entity is added to the portal, the keywords used should be selected from a predefined list, so as not to allow free text input."

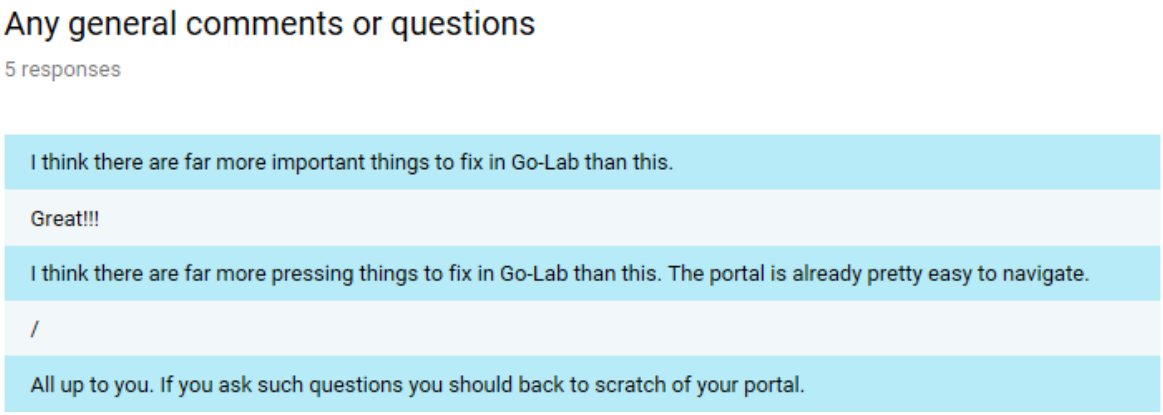


Figure 39. Responses to the statement "Any general comments or questions"

The overall assessment derived from these results is presented in Section 7.4.1.

MM. Detailed Results on Peer-assessment from the Ambassadors Workshop in Brussels (LEIC-06052017b)

For the first question: What students would it be most appropriate for? The general feeling was for older or talented students. Ambassadors expected high achievers in secondary school to be the most fitted students to evaluate their peers' work, and only a couple suggested that university or primary school levels would be a more adequate target for peer assessment practices.

For the second question: What improvements would you suggest? About half of the group recommended an automatic or random matching of students. A few people thought it was necessary to translate the tool into all EU national languages for easier use of students with low level of English proficiency. A couple of ambassadors suggested to add self-reflection and the use of ontologies as part of the peer assessment structure. And one person described the tool to be perfect as it is.

For the third question: What main benefits do you expect? Most ambassadors pointed out the increase of self-confidence that peer assessment could trigger in the pupils once they become more attentive to their own work. Additionally, they mentioned the great potential for the students to become critical thinkers, to improve their communication and language skills and to more collaboratively work with other peers through a web-based platform.

For the last question: What concerns would you have about this? By far the biggest concern ambassadors had is time. More specifically, the lack of time they have to include this process in the classroom, the amount of effort that it will take them to teach students how to use the tool and also how to provide good and meaningful feedback to other students. Similarly, a few teachers thought that young students would not be very objective or sensitive while giving feedback, and that it could be taken as criticism rather than help for some.

The overall assessment derived from these results is presented in Section 7.4.2.

NN. Detailed Results from Analytical Study on Suitability of the Next-Lab Apps for Primary School Students (LEIC-30052017)

Table 34. Responses from analytical study on suitability of apps for primary school students (P1, P2, P3 = participant identifiers; ease of use and easy to understand were rated on a scale from 0 (not at all) to 5 (very much); age range could be specified from a minimum of 6 to a maximum of 18))

App	Ease of use			Easy to under-stand			Age range			Students and/or teachers		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
Action Statistics	5	5	5	4	4	4	8-12			Teachers and students	Teachers only	Teachers only
Automatic Generator of User Interfaces for Smart Labs	3	3	3	3	3	3				Teachers only?	Teachers only?	Teachers only?
Calculator	5	5	5	5	5	5	8-12	8-12	8-12	Students	Students	Students
Chempy	4	4	4	2	2	2	10-12 +	12 +	10-12 +	Students	Students	Students
Concept Map Aggregation	5	5	5	4	4	4				Teachers only	Teachers only	Teachers only
Concept Map Dashboard	4	4	4	4	4	4				Teachers only?	Teachers and students	Teachers and students
Concept Mapper	5	5	3	4	4	3	8-12	8-12	8-12	Students	Students	Students
ConceptCloud	5	4	3	4	4	4	8-12	8-12	12 +	Students and teachers	Students and teachers	Students and teachers
Conclusion Tool	2	3	3	2	2	2	10-12	10-12	12 +	Students	Students	Students
Data Viewer	2	2	3	2	2	2	10-12	10-12	10-12	Students	Students	Students

App	Ease of use			Easy to understand			Age range			Students and/or teachers		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
Equation Editor	2	2	2	2	2	2	10-12	10-12	10-12	Students	Students	Students
Experiment Design Tool	1	3	1	1	3	1	12+	8-12	10-12	Students	Students	Students
Experimental Error Calculator	1	1	1	1	1	1	12+	12+	12+	Students	Students	Students
File Drop	4	4	4	4	4	4	8-12	8-12	8-12	Students	Students	Students
Function Plotter	2	2	2	2	2	2	10-12	10-12	10-12	Students	Students	Students
Geogebra	2		2	1	1	1	12+	12+	12+	Students	Students	Students
GoModel	3	3	3	2	2	2	10-12+	10-12	10-12+	Students	Students	Students
Hypothesis Scratchpad	4	4	4	3	3	3	8-12	8-12	8-12	Students	Students	Students
Input Box	5	5	5	4	5	4	8-12	8-12	8-12	Students	Students	Students
Mindmeister Widget	3	3	3	3	3	3	10-12	10-12	10-12	Students	Students	Students
Observation Tool	4	4	4	4	4	4	8-12	8-12	8-12	Students	Students	Students
Online users visualisation	5	4	5	4	4	4		8-12		Teachers only	Students and teachers	Teachers only
Padlet	2	4	4	4	4	5	8-12	8-12	8-12	Students	Students	Students
Periodic Table	4	4	4	2	2	2	10-12+	12+	10-12+	Students	Students	Students

App	Ease of use			Easy to under-stand			Age range			Students and/or teachers		
	P1	P2	P3	P1	P2	P3	P1	P2	P3	P1	P2	P3
Progress Bar	4	4	4	5	5	5	8-12	8-12	8-12	Students	Students	Students
Quest	5	5	5	4	5	4	10-12	10-12	8-12	Students and teachers	Students and teachers	Students and teachers
Question Scratchpad	4	4	4	4	4	4	8-12	8-12	8-12	Students	Students	Students
Quiz tool	5	5	5	5	5	5	8-12	8-12	8-12	Students and teachers	Students and teachers	Students and teachers
Reflection Tool	5	4	5	4	3	4	9-12	9-12	9-12	Students	Students	Students
Reflection Tool (transitions)	4	4	4	3	3	3	8-12	10-12	8-12	Students	Students	Students
Report tool	5	5	5	4	4	4	10-12	10-12	8-12	Students	Students	Students
Semantic Group Formation App	4	4	4	4	4	4				Teachers only?	Teachers only	Teachers only?
Shared Wiki	4	4	4	3	3	3	8-12	8-12	8-12	Students	Students	Students
SpeakUp	4	4	4	5	5	5	8-12	8-12	8-12	Students	Students	Students
SSH Webconsole FORGEBox widget	1	1	1	1	1	1	12+	12+	12+	Students	Students	Students
Student time spent	5	5	5	5	5	5				Teachers	Teachers	Teachers
Submitted files in ILS	4	4	4	5	5	5				Teachers	Teachers	Teachers

App	Ease of use			Easy to under-stand			Age range			Students and/or teachers		
	P 1	P 2	P 3	P 1	P 2	P 3	P1	P2	P3	P1	P2	P3
Sysquake	1	1	1	1	1	1	12 +	12 +	12 +	Students	Students	Students
Table tool	4	5	4	4	5	4	8-12	8-12	8-12	Students	Students	Students
Teacher Feedback	5	5	5	4	4	4	8-12	8-12	8-12	Students and teachers	Students and teachers	Students and teachers
Timeline	5	5	5	4	4	4				Teachers	Teachers	Teachers
Wiki App	4	4	4	3	3	3	8-12	8-12	8-12	Students	Students	Students

The overall assessment derived from these results is presented in Section 7.4.3.

OO. Details for CGT Task: Suitability of Apps for Younger Students (LEIC-23062017)

To get additional feedback on the suitability of apps for primary school students, not only from researchers, a CGT task replicating the analytical activity was given to teachers.

The gathered data is presented in Table 35, for better readability the following abbreviations are used for the statements:

- Ease of use = Please rate how easy it would be for students age 8-11 to use this app on a scale from 0 (not at all) to 5 (very much).
- Easy to understand = Please rate how easy it would be for students age 8-11 to understand the content of this app on a scale from 0 (not at all) to 5 (very much).
- Age range = Please specify the age range (from minimum 6 to maximum 18) for which this app would be suitable.
- Students and/or teachers = Please specify in this column if you think this app is for students, teachers, or students & teachers.

Table 35. Responses of the rating on suitability of apps for younger students task (P1, P2, P3, P4 = participant identifiers)

App	Ease of use				Easy to understand				Age range				Students and/or teachers			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
Action Statistics	1	0			1	2			14 to 17	16 +			T	T		
Automatic Generator of User Interfaces for Smart Labs	0	1			0	1			16 to 18	16 +			S&T	S& T		
Calculator	5	5			5	5			8 to 14	6+			S	S		
Chempy	1	0			1	0			12 to 14	15			S	S& T		
Concept Map Aggregation	3	1			3	1			10 to 14	14			S&T	S& T		
Concept Map Dashboard	2	1			2	1			13 to 14	14			S&T	S& T		
Concept Mapper	5	2			4	2			6 to 15	12			S	S& T		

App	Ease of use				Easy to understand				Age range				Students and/or teachers			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
ConceptCloud	4	1			4	1			8 to 18	12			S&T	T		
Conclusion Tool	3	2			3	2			10 to 14	14			S&T	S&T		
Data Viewer	2	3			2	3			11 to 18	10			S	S&T		
Equation Editor	1	1			1	1			12 to 18	15			Doesn't work	S&T		
Experiment Design Tool	0	3			1	3			13 to 18	8			S&T	S&T		
Experimental Error Calculator	0	0			0	0			14 to 18	15			S	S&T		
File Drop	2	2			2	2			8 to 18	10			S&T	S&T		
Function Plotter	0	0			0	0			16 to 18	14			S&T	S&T		
Geogebra	1	2			2	2			12 to 18	8			S&T	S&T		
GoModel	0	0			0	0			13 to 18	16 +			S	S&T		
Hypothesis Scratchpad	3	3			3	3			11 to 18	8			S&T	S&T		
Input Box	5	2			5	2			6 to 18	10			S	S&T		
Mindmeister Widget	1	0	2		2	0	2		14 to 18	16 +	12 to 18		S&T	S&T	S&T	
Observation Tool	2	2	5		3	2	4		8 to 18	10	8 to 16		S	S&T	S&T	

App	Ease of use				Easy to understand				Age range				Students and/or teachers			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
Online users visualisation		0	4	4		0	4	4		No	8 to 16	8 to 18		T	S& T	T
Padlet		4	3	3		4	3	3		8	10 to 16	8 to 18		S& T	S& T	S
Periodic Table		1	0	0		1	1	0		14	14 to 18	12 to 18		S& T	S& T	S& T
Progress Bar		0	1	4		0	5	4		14	14 to 18	8 to 18		S& T	S& T	S& T
Quest		0	5	3		3	5	3		8	6 to 18	8 to 18		T	S& T	T
Question Scratchpad		1	3	3		2	0	3		14	10 to 18	8 to 18		S& T	S& T	T
Quiz tool		1	5	4		3	5	4		8	6 to 18	8 to 18		T	S& T	T
Reflection Tool		0	3	2		0	3	2		16 +	10 to 18	12 to 18		S& T	S& T	S
Reflection Tool (transitions)		0	3	2		0	0	2		16 +		12 to 18		S& T	S& T	S
Report tool		1	3	3		2	3	3		14	12 to 18	12 to 18		S& T	S& T	S& T
Semantic Group Formation App		0	0	0		0	3	0		18		17 to 18		T	T	T
Shared Wiki		0	3	2		0	3	2		16 +	14 to 18	12 to 18		S& T	S& T	S& T
SpeakUp		0	5	3		0	5	3		16 +	8 to 18	12 to 18		S& T	S& T	S
SSH Webconsole		0	0	0		0	5	0		16 +	14 to 18	17 to 18		S& T	S& T	T

App	Ease of use				Easy to understand				Age range				Students and/or teachers			
	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4	P1	P2	P3	P4
FORGEBox widget																
Student time spent		1	3	3		1	5	3		12	14 to 18	12 to 18		T	T	S& T
Submitted files in ILS		1	2	3		1	3	3		12	12 to 18	12 to 18		S& T	T	S& T
Sysquake		0	0	0		0	0	0		14	14 to 18	14 to 18		S& T	S& T	S& T
Table tool		5	1	4		5	3	4		8	12 to 18	10 to 18		S& T	S& T	T
Teacher Feedback		1	4	4		4	4	4		8	8 to 18	10 to 18		T	S& T	S& T
Timeline		0	2	3		1	5	3		14	10 to 18	10 to 18		S& T	T	S& T
Wiki App		0	2	3		1	4	3		16 +	14 to 18	10 to 18		S& T	S& T	S& T

The following existing apps are suitable for primary school students (age 8 to 11) based on all the teachers rating this app:

- Calculator
- Data Viewer
- File Drop
- Hypothesis Scratchpad
- Input Box
- Observation Tool
- Padlet
- Quest
- Quiz tool
- Teacher Feedback

The following apps are suitable for primary school students (age 8 to 11) from the perspective of at least one but not all raters:

- Concept Map Aggregation
- Concept Mapper
- ConceptCloud
- Conclusion Tool
- Experiment Design Tool
- Geogebra
- Online users visualization
- Progress Bar
- Question Scratchpad
- Reflection Tool
- SpeakUp
- Table tool
- Timeline
- Wiki App

The following apps are not suitable for primary school students, based on the ratings from all teachers:

- Action Statistics
- Automatic Generator of User Interfaces for Smart Labs
- Chempy
- Concept Map Dashboard
- Equation Editor
- Experimental Error Calculator
- Function Plotter
- GoModel
- Mindmeister Widget
- Periodic Table
- Reflection Tool (transitions)
- Report tool
- Semantic Group Formation App
- Shared Wiki
- SSH Webconsole FORGEBox widget
- Student time spent
- Submitted files in ILS
- Sysquake

The description of the task obtaining these results is described in Section 5.2 and an overall assessment derived from these results is presented in Section 7.4.3.

PP. Questions Facilitation the Discussion about Chat Functionality at the Ambassadors Workshop in Brussels (LEIC-06052017b)

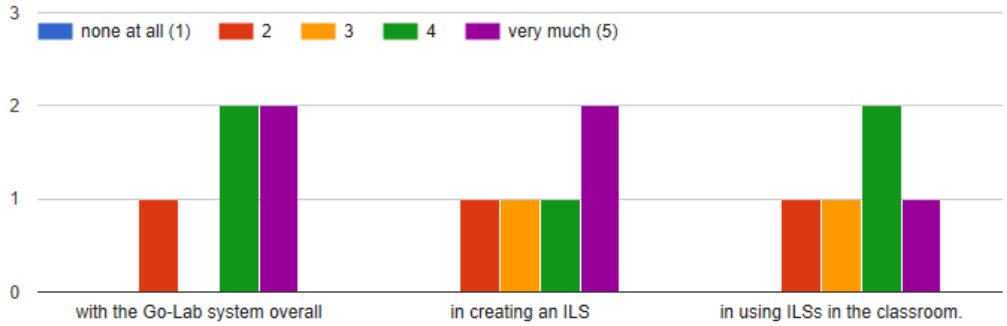
Facilitated discussion questions:

- (textual) Chat facilities – often used as add-ons in web-based games or social media sites. Would it be useful to introduce them into some of the Go-Lab artefacts – e.g. some of the more collaborative labs or apps?
- If so, which apps or labs do you know which might benefit from a chat feature?
- Should the teacher be able to read (or “spy on”) all the chats?
- Instead of adding chat to certain apps or labs, would it be useful to have a general chat facility for any student in an ILS? If so, would they be able to chat only to others in the same ILS, or to any student in any ILS?

The findings derived from the discussion of these questions is presented in Section 7.4.4.

QQ. Detailed Responses to the Chat Questionnaire (LEIC-07072017)

Please rate your experience on the following scales:



What age range are your students?

5 responses

15-21
11-15
11-16
10 - 15
12-14

Figure 40. Responses to background questions in the chat questionnaire

Table 36. Responses on the questions on activities in the chat questionnaire

Activity	1 (not needed)	2	3	4	5 (very important)
Allow students to ask questions to teacher				1	4
Allow students to ask questions to fellow students			1	2	2
Allow students to reply to questions of other students				4	1
Brainstorm				1	4
Allow teachers to provide feedback					5
Allow students to provide feedback to other students				2	3
Allow students to comment on the learning activities				1	4
Allow students to share ideas				1	4
Allow students to share experiences from the online lesson				3	2

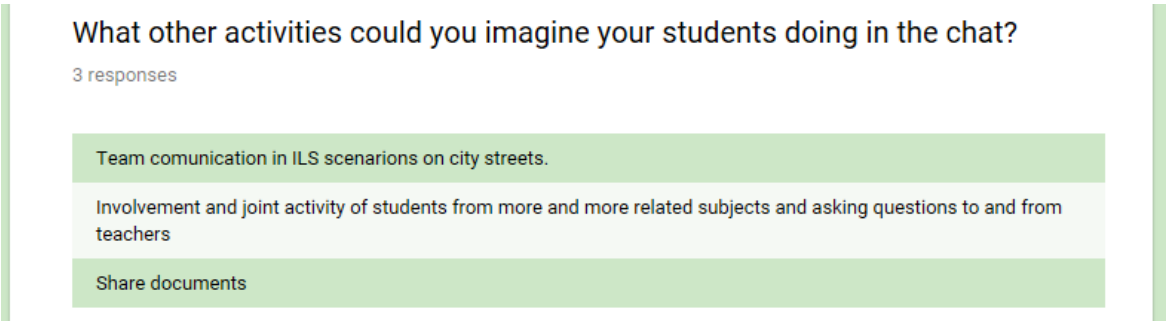


Figure 41. Responses on the question on other activities in the chat questionnaire

Table 37. Responses on the questions on features in the chat questionnaire

Feature	1 (not needed)	2	3	4	5 (very important)
Private chat with individual other students	2	2		1	
List of other students in the chat		1	2	2	
Anonymity (don't show usernames of the students)	3	1			1
Rating of messages (thumb up/down)	1	2	1	1	
Reply to individual messages (second level/hirarchy of messages)		1	2	2	

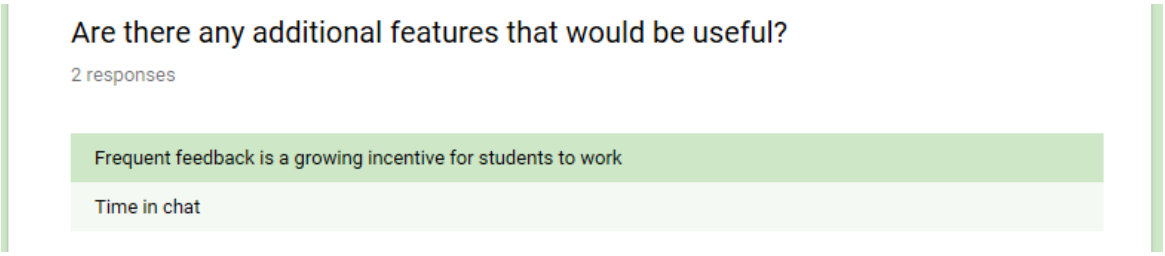


Figure 42. Responses on the question on additional features in the chat questionnaire

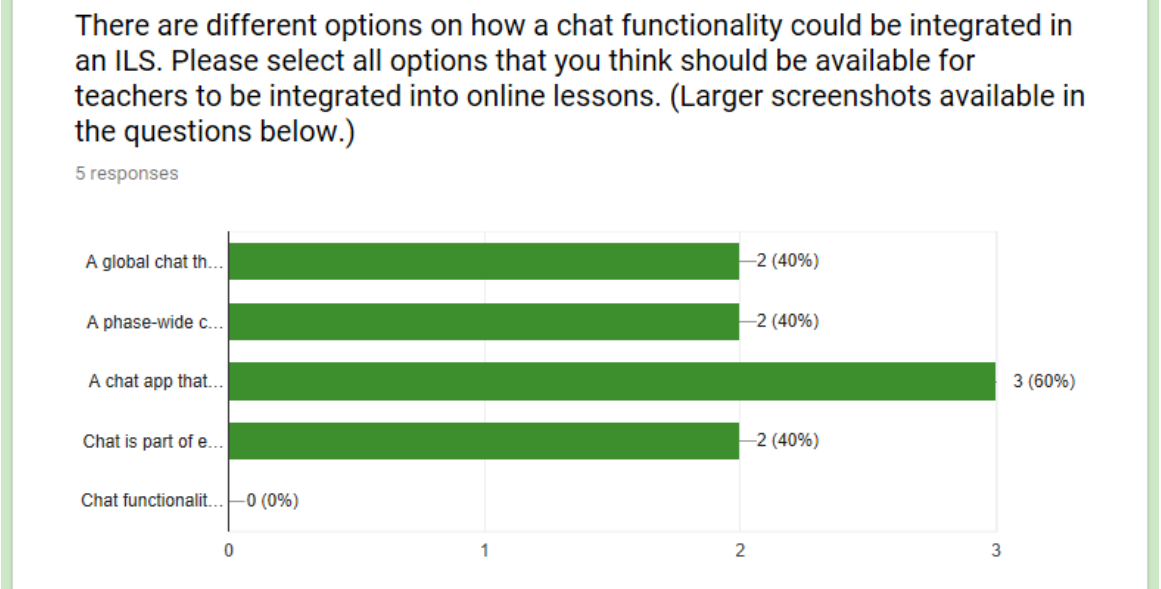


Figure 43. Responses to question on chat integration from the chat questionnaire

The answer options in Figure 43 are truncated, the complete options are:

- A global chat that is visible throughout the whole ILS/online lesson.
- A phase-wide chat, which shows only the messages of users written in the current phase.
- A chat app that can be integrated at different positions in phases. The chat would then only be available at the position where it was added.
- Chat is part of existing apps (e.g. the concept mapper app). The chat would then only be available while working with the app(s) that include a chat.
- Chat functionality is not necessary in ILSs.

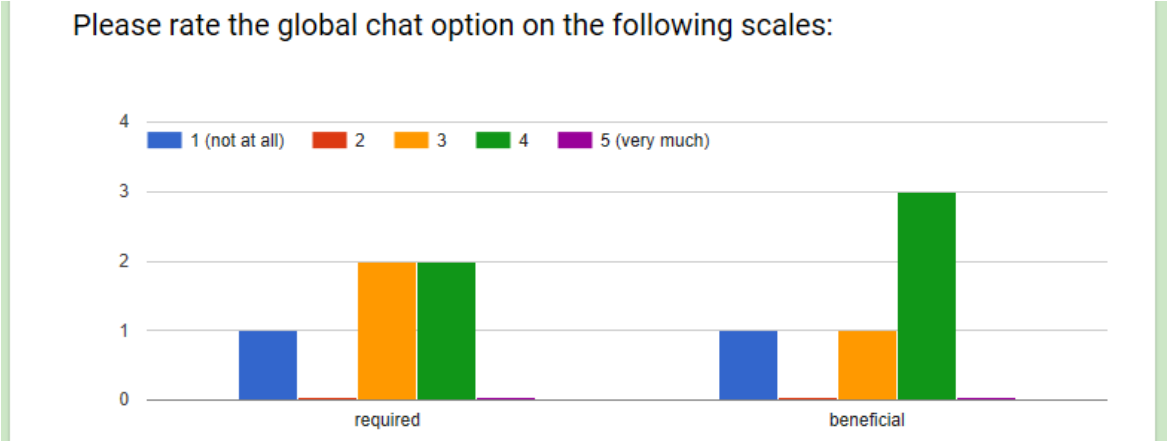


Figure 44. Responses to questions on Global Chat option in chat questionnaire

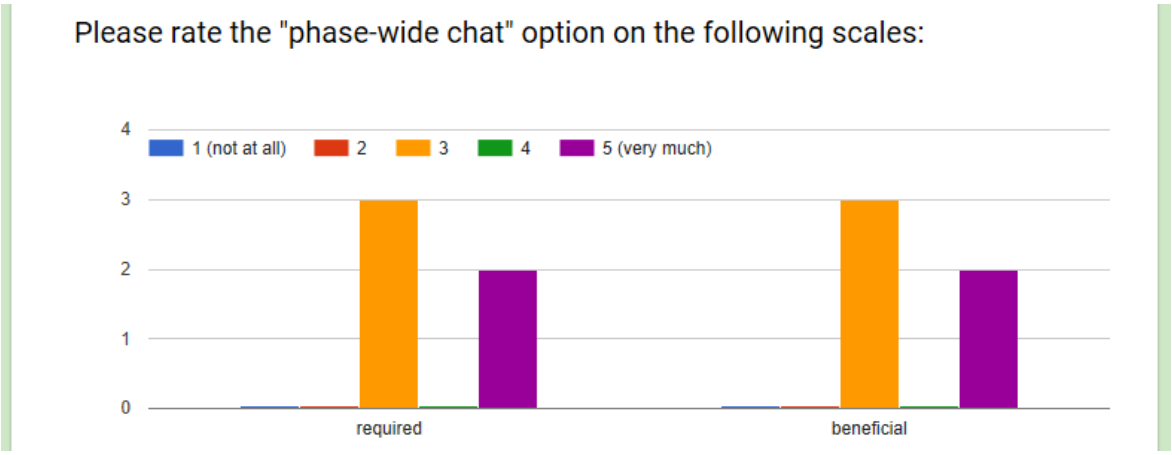


Figure 45. Responses to questions on Phase-wide Chat option in chat questionnaire

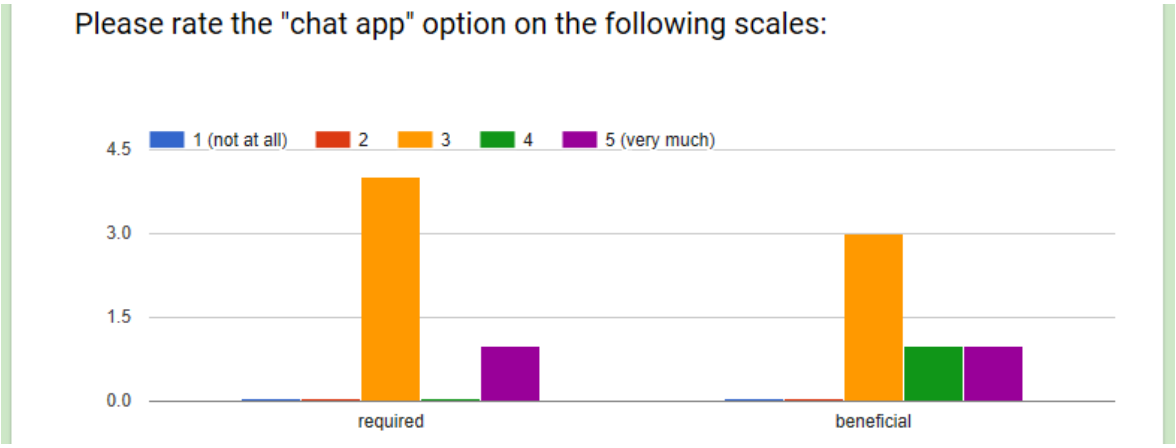


Figure 46. Responses to questions on Chat App option in chat questionnaire

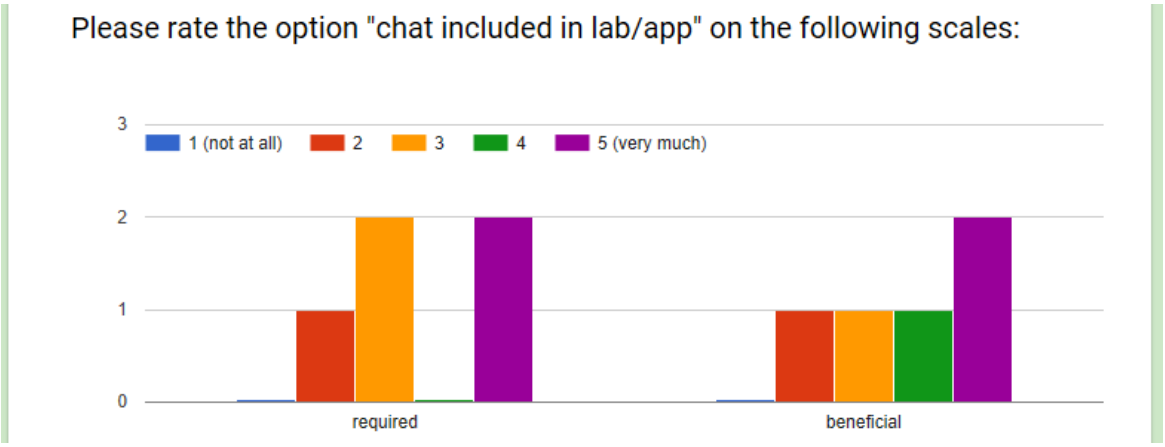


Figure 47. Responses to questions on Chat Included in Lab/App option in chat questionnaire

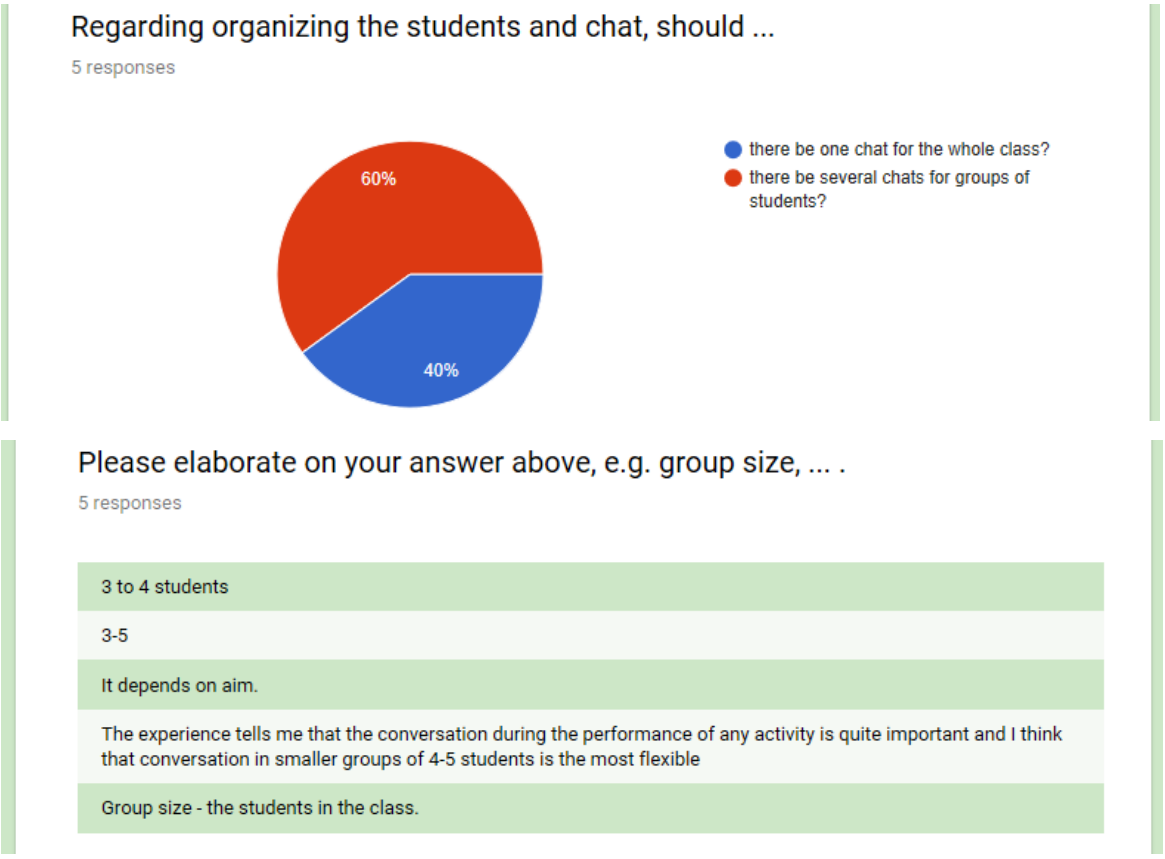


Figure 48. Responses to questions on organizing the chat

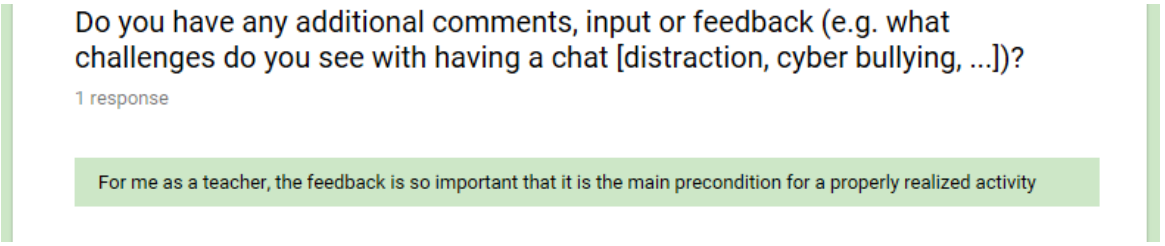


Figure 49. Response to question regarding additional comments in the chat questionnaire

The overall assessment derived from these results is presented in Section 7.4.4.

RR. Detailed Feedback Gathered on Scenario Integration Using PDotCapturer During the Twilight Session for Teacher Trainers (LEIC-13062017)

Scenario Integration in the Go-Lab sharing platform:

- Neutral comment (1)
  - [2]: I think there is too much writing and text could be shortened
- Negative comments (2)
  - [1]: Change colour to stand out when first look at page
  - [3]: change colour -at moment it is lost in page colours

Scenarios overview page on the Go-Lab sharing platform:

- Positive comment (1)
  - [3]: I find the diagrams engaging
- Neutral comment (1)
  - [1]: Put picture scenarios first and less writing
- Negative comments (2)
  - [2]: better as a list -3 bullet points
  - [4]: eyes are drawn to diagrams and miss out text above.

Basic scenario (for a blank ILS containing only the default phases):

- Positive comment (1)
  - [1]: I think this give a good simple introduction and the picture is clear
- Neutral comment (1)
  - [2]: Further reading could be linked to hyperlinks to ensure accessibility made easier
- Negative comments (3)
  - [3]: list the 5 stages-bullet point? each one can have an extra comment or link to further information
  - [4]: linked to previous comment -reposition as indicated
  - [5]: reduce text overall impression is too much reading-make it available through a link `introduction?`

Find the mistake scenario:

- Neutral comment (1)
  - [1]: You could have this text so that it is opened out if someone wants to read this level of detail
- Negative comments (3)
  - [2]: spelling error
  - [3]: somehow split this text-advantages/disadvantages? list or bullet points?hyperlink further info
  - [4]: spelling!

Learning by Critiquing scenario:

- Positive comment (1)
  - [1]: Useful skills being developed through finding mistake, critquing, etc...
- Negative comment (1)
  - [2]: same comment for all pages-break down text-teachers are busty people-they need to get to the main points quickly

Structured controversy scenario:

No feedback has been given in PDotCapturer on the structured controversy scenario

Six thinking hats scenario:

- Neutral comment (1)
  - This level of information is useful but as a teacher you may quickly want to go on and see what I can do with my students and see how they are going to engage with it

Jigsaw approach scenario:

- Positive comments (3)
  - [2]: Cooperative learning a good approach to getting students to share ideas, solving problems and communicating
  - [3]: This description helps the teacher understand how to use the methodology as to using the Jigsaw scenario
  - [5]: good that much of this text is a practical discussion of how to organise this activity
- Neutral comment (1)
  - in other sections the text was too abstract -this text is far more practical-it is what the teachers want.
- Negative comments (2)
  - [1]: See earlier comments as they are relevant for all these scenario tabs
  - [4]: If the teacher could be given the headlines as to what the steps are:
    Students Collaborative Learning
    Home group - describe
    Expert group - describe
    Show picture...
    Skills developed...
    Pathwasy - Hypothesis eg...

Scenario integration in Graasp:

- Negative comments (2)
  - [1]: Before creating a scenario, I would like to see an example for each scenario
  - [2]: I would like to be ale to see a basic example of each scenario before starting to build my own.

The overall assessment derived from these results is presented in Section 7.4.5.

SS. Detailed Feedback Gathered on Scenario Integration Using PDotCapturer at the Next-Lab Summer School 2017 (LEIC-11072017d)

In total 55 comments have been provided regarding the screenshot of the scenario integration in the Go-Lab sharing platform:

- Positive comments (48)
  - *without textual description:* 43
  - offer interactive activities *[on description text of Inquiry Spaces]*
  - great idea to introduce new scenario
  - is good that you can look for materials for the age that you are looking for. *[on Age ranges filter]*
  - I like the fact that it helps you find your way. *[on the description text of Inquiry Spaces]*
  - I like this as it gives examples *["Check out the scenarios" link]*
- Neutral comments (4)
  - *without textual description:* 1
  - should have multiple choices: Domain+Langouage... *["Sort by" dropdown]*
  - i know where scenarios are *["Check out the scenarios" button]*
  - Neutral *["Check out the scenarios" button]*
- Negative comments (3)
  - One of the two statistics is enough *[Statistics on content of the repository]*
  - too much text at once... *[description of inquiry spaces]*
  - Scenarios should be up here *[comment in the menu, next to "Inquiry Spaces"]*

One negative comment on this page, which is shown in Figure 50, is unrelated to the scenarios, it states that one of the statistics visualizations would be enough.

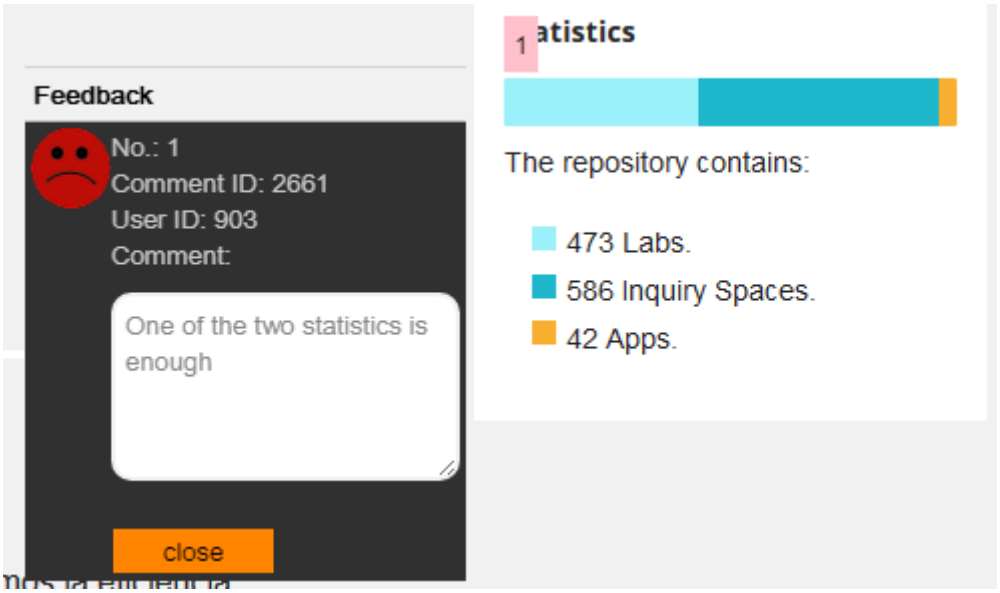


Figure 50. A negative statement unrelated to scenarios, which should still be addressed in the re-design of the Go-Lab sharing platform

In total 22 comments have been provided regarding the screenshot of the scenarios overview page on the Go-Lab sharing platform:

- Positive comments (19)
  - *without textual description:* 13
  - especially *
    *FIND MISTAKE
    *CONTROVERSY
    [general comment on the page]
  - It is very interesting and useful. I only have used the basic scenario and this give me a chance to vary activities. I find specially useful, find the mistake, six thinking hats and Jigsaw. *[general comment on the page]*
  - good to introduce this teaching methodes. They are clear and easy to follow *[comment on "description of each scenario"]*
  - Very good and invormative! Keep! *[comment next to the heading "Scenarios"]*
  - Give practical examples of different ways to use inquiry *[comment next to the heading "Scenarios"]*
  - Descriptions provided for each scenario are useful for one to build his own ils *[comment on "description of each scenario"]*
- Neutral comments (3)
  - *without textual description:* 2
  - I like this aproach, but the scenario doesnt fit for 100 percent Jicsaw aproach. We think may be it will be better to decrease the number of steps in the scenario, and that every step will fit the step in Jicsaw aproach
- Negative comments (0)

In total 14 comments have been provided regarding the screenshot of the basic scenario (for a blank ILS containing only the default phases):

- Positive comments (12)
  - *without textual description:* 9
  - because is structured
  - Very useful, you are free to implement any kind of ILS. It is great to follow the scientific method.
  - Basic scenario is very comfortable for usage
- Neutral comments (2)
  - *without textual description:* 1
  - I like this but would like a simpler version for primary students
- Negative comments (0)

In total 7 comments have been provided regarding the screenshot of the find the mistake scenario:

- Positive comments (7)
  - *without textual description:* 1
  - Very interesting scenario model. helps to wonk on critical thinking skills in a structure way
  - Veru useful
  - because learning is identify misconceptions
  - Very good to misconceptions, easy to do and effective.

    - Very good! Easy to follow! Keep!
    - This gets the students to think. This involves higher order skills.
- Neutral comments (0)
- Negative comments (0)

In total 7 comments have been provided regarding the screenshot of the learning by critiquing scenario:

- Positive comments (6)
    - *without textual description:* 1
    - It is the scenario that my team worked on. At first it was difficult to conclude on theme that could be applied to the specific scenario.
      I need more time thinking and promoting ideas in a meaningful way. It is challenging and I never thought of using this teaching approach before the school lab.
      As we have the ability to keep or hide phases, it is a dynamic tool to our hands. I am sure I will use it and send more cooments
    - A difficult scenario, but extremely useful if it is structured well. Our team at the Summer School 2017 accepted this challenge and presented very good scenarios "Is the Earth Flat"
    - because Being critical is a skill in our century
    - Very useful but I hink is difficult to implement
    - A good description but I would break it in smaller parts.I prefer that I'm introduced to the scenarios by someone who has experienced them. Then the info provided will be useful.
- Neutral comments (1)
    - I have to test it in the classroom.
- Negative comments (0)

In total 4 comments have been provided regarding the screenshot of the structured controversy scenario:

- Positive comments (2)
    - *without textual description:* 1
    - Ithink this is the more usef ul scenario of all
- Neutral comments (2)
    - *without textual description:* 1
    - You can structure controversy inside other scenarios
- Negative comments (0)

In total 5 comments have been provided regarding the screenshot of the six thinking hats scenario:

- Positive comments (5)
    - *without textual description:* 2
    - especially at DISCUSSION
    - It is very good for controversial topics. I want to try it in my classes.
    - its easy to understand the description of the scenario
- Neutral comments (0)
- Negative comments (0)

In total 11 comments have been provided regarding the screenshot of the jigsaw approach scenario:

- Positive comments (9)
  - *without textual description:* 4
  - iS A METODOLOGY FOR DIVERSITY STUDENTS
  - Great for teamwork, to make projects also.
  - its good for introduction of Jicsaw approach *[comment on Orientation phase]*
  - We think that it will be important to emphasy that 2 steps (data interpretation and conclusion)fit the work at mothers'original groups *[comment on Conclusion phase]*
  - we (<participant names redacted>) enjoyed the scenario
- Neutral comments (1)
  - There is not so clear where students work in original group and where in mother groups *[comment on Hypothesis (Conceptualisation) phase]*
- Negative comments (1)
  - its not clear to which kind of group mother group or expert group this stage is related *[comment on Experimentation (Investigation) phase]*

In total 2 comments have been provided regarding the screenshot of the scenario integration in Graasp:

- Positive comments (1)
  - HELP TO ORGANIZE ALL OUR ACTTIONS: classroom, training, community schools, sharing
- Neutral comments (1)
  - a bit more information...
- Negative comments (0)

The overall assessment derived from these results is presented in Section 7.4.5.

TT. Detailed Feedback Gathered on Scenario Integration Using PDotCapturer for a Next-Lab PD and Core Group Teacher Task (LEIC-04082017)

Scenario Integration in the Go-Lab sharing platform:

- Positive comments (2)
  - [2]: {Marker on the “Check out the scenarios” button} I like the button, is quite visible
  - [4]: The fact that we can adapt scenarios that are already done is perfect.
- Neutral comment (1)
  - [3]: {Line drawn in between “Publishing Inquiry Spaces” section and “We would be glad to hear from you…”} I would add here a line explaining what publishing involves a bit more clearly (other teachers can search and copy your ILS and modify it)
- Negative comment (1)
  - [1]: {Frame drawn around the “How to create an inquiry space” and “Use scenarios to create Inquiry Spaces.” sections} I don't like the way it's written.
    I would change this long paragraph in a bulleted list with the three possibilities (from the lab, from another ILS and from scenarios).
    I would include scenarios as the third option if you want to give them relevance. Currently is separated, it doesn't invite to use it unless you are specially interested

Scenarios overview page on the Go-Lab sharing platform:

- Positive comments (7)
  - [1]: {Line drawn around the “Find the mistake” image} I like the pictures... don't know why, I'm not a designer... I just liked them
  - [3]: {Marker on “Scenario-Basic scenario” icon} This is the scenario i´m most familiar with.
  - [4]: {Marker on “Scenario-Jigsaw approach” icon} I´ve never tried this scenario. The time to materialize is very high.
  - [5]: {Marker on “Scenario-Six thinking hats” icon} Seems like na interesting scenario to use in the classroom.
  - [6]: {Marker on “Scenario-Learning by Critiquing” icon} This is a type of scenario that has to be used by high school students.
  - [7]: {Marker on “Scenario-Find the mistake” icon} Very interesting. I will try to use it in my classes.
  - [8]: {Marker on “Scenario-Structured controversy” icon} Is a kind of scenario to use at the end of period.
- Negative comments (2)
  - [2]: Sorry, but I think the deffinition is quite unclear... I mean, if I already know what a scenario is, I can understand it. But if I have no idea what a scenario is, I stay the same way after reading this two lines...
    I would say something like "scenarios are differents structures proposed for ILS that deal or emphasize differents aspects of inquiry..." ... don't know, but something more specific
  - [9]: {Marker on the left hand side of the top menu with an arrow to the handwritten word “Scenarios”} Creat a link only for the scenarios

Basic scenario (for a blank ILS containing only the default phases):

- Positive comments (2)
  - [1]: I appreciate that the general aspect of the page is familiar and similar to the structure found in ILS and Labs pages
  - [5]: In each phase should have information on what is intend.
- Neutral comments (3)
  - [2]: Again, paragraphs are really long, and the writing is a bit complicated (may be it's my level of english, sorry...) I but use more commas and more lists.
    In this picture there are three paragraphs, but in the current version in the web is everything written in a single paragraph.
    Taking into account that the greatest part of the users won't be English native spokers, I would simplify, structure and shorten the paragraphs to the relevant information for the teacher.
  - [3]: Why do tou repeat the title?
    The links provided in the web are to graasp pages that doesn't exist.
    I think it would be easier to have here a short explanation (just two lines) about the manong of every phase.
  - [4]: Links are great, but I would include some further reading with direct links to the material... really few teachers will take the time to look for the articles.

Find the mistake scenario:

- Positive comments (2)
  - [1]: Similar comments to the previous page... good general aspect, I would improve the way description is written, I would include a short description of the phases, and eliminate the not working links, and I would include somre reference to go further avalaible in internet with direct link, if possible
  - [2]: Interesting to apply.

Learning by Critiquing scenario:

- Positive comment (1)
  - *without textual description:* 1
- Neutral comment (1)
  - [1]: Comments similar to two previous scenarios... in this case, I would emphasize the difference with the previous find the mistake scenario, it's not clear at the beginning

Structured controversy scenario:

- Positive comment (1)
  - *without textual description:* 1
- Neutral comment (1)
  - [1]: Same comments that in previous pages...

Six thinking hats scenario:

- Positive comment (1)
  - [2]: The graphical representation is adequate
- Neutral comments (2)
  - [1.1]: Same comments as in previous pages.

    - [1.2]: I would include a picture, a link or a short explanation with the meaning of each hat... anyway, the idea is complex and uncommon enought in science enviroment. It will need further explanation before any teacher that doesn't knew the technique use it..

Jigsaw approach scenario:

- Positive comment (1)
    - [3]: Interesting, but it is a complex scenario for a normal classroom.
- Neutral comment (1)
    - [1]: Same comments as in previous scenarios
- Negative comment (1)
    - [2]: I know the technoque, but from this explanation I'm not able to understand how I'm supposed to apply it

Scenario integration in Graasp:

- Positive comments (3)
    - *without textual description:* 1
    - [2]: I like the impression that there are no big changes in the way graasp works when using different scenarios. They look to behave just as different templates, and that makes it easy
    - [3]: {Marker on Intercom interface} Excelent for doubts during the elaboration of ILS.
- Neutral comment (1)
    - [1]: I haven't worked with ILS created from differents scenarios... so I can't say if I will find any difference when designing them with graasp.

The overall assessment derived from these results is presented in Section 7.4.5.

UU. Detailed Findings from the Analytical Walkthrough Performed for the ILS Publishing Functionality of the Go-Lab System (LEIC-22052017)

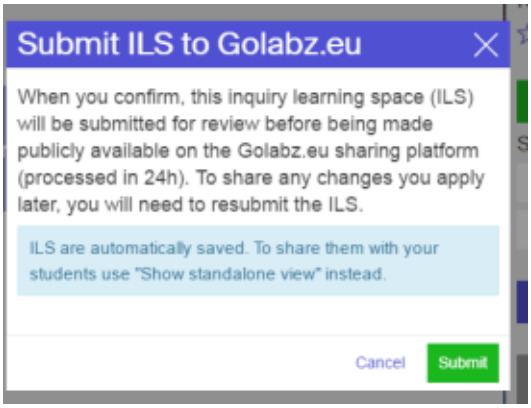
The suggestions in this section are somehow speculative, based on our understandings of what we believe teachers we have worked with would like. For more representative data collection, teachers who have experienced problems during the process of publishing an ILS could be interviewed, and their usability issues be consequently analysed.

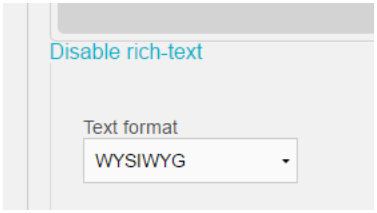
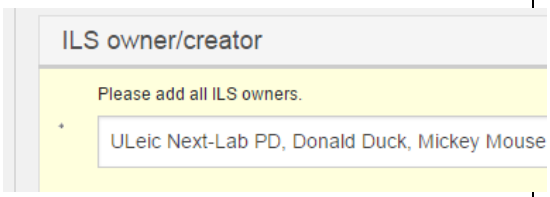
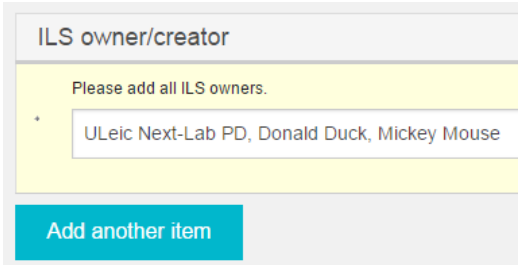
A. From our observations and discussions with teachers we believe they could encounter usability problems due to:
   a. a misunderstanding of publishing concepts, or
   b. a confusing workflow and change of platforms during the publishing process, or
   c. the inability to fill in forms correctly, or
   d. difficulty to find help.

B. Some ideas to prevent the beforehand possible complications include:
   a. providing help at the point where it is associated to, so that it is easily accessible and does not have to be searched.
   b. updating support resources like video tutorials to reflect the current process and looks of Graasp and the Go-Lab sharing platform, therefore providing efficient support throughout the whole process of publishing an ILS.
   c. improving the interface slightly, taking special care of phrases and words displayed to the user.
   d. providing appropriate descriptions or links to help and support services in order to facilitate the users' understanding of the process and all steps involved.

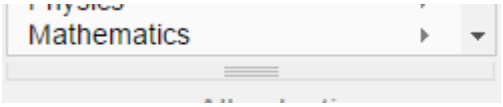
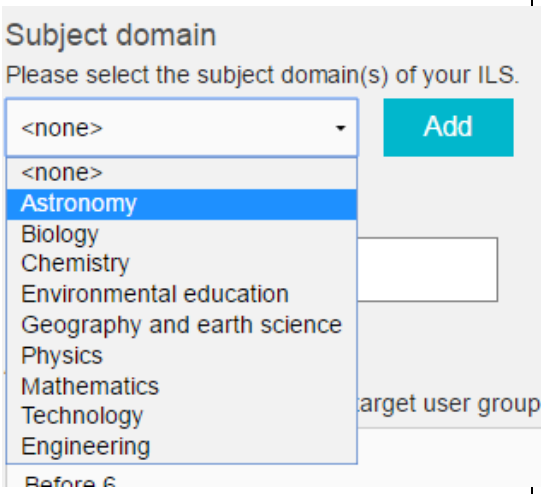
The entries in the following table are presented in 'chronological' order of encountering them during the evaluation session (not sorted by Importance), to make it easier to follow the process and identify the position of the described issues in the process and on the websites.

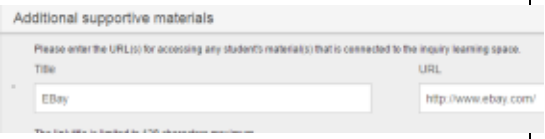
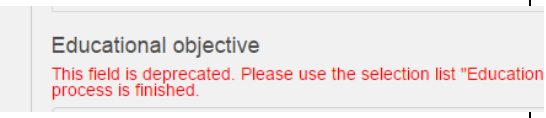
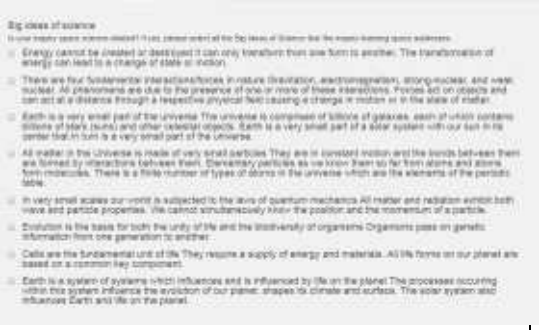
	Usability Observation	Recommended Modification	Import-ance
1	No help facilities to guide the teacher throughout the process. 	Provide help that is consistent with the current process. Update resources that are no longer accurate (e.g. video tutorial of publishing). Provide direct access to any help services or guidance notes when clicking the 'Submit Inquiry Space' button.	**H**
2	Button labelling is not clear. 'Submit' is not the same as 'Publish', and could mislead the user. 	Renaming it to 'Publish ILS' and add a tooltip (when hovering) saying 'Start the process to publish the Inquiry Learning Space on the Go-Lab sharing platform' for example.	**L**

	Usability Observation	Recommended Modification	Import-ance
3	Phrasing of popup message could be improved. 	Something like 'When you finish this process', 'Once you submit your ILS'.	**L**
4	Button on popup message could be clearer. 	'Next', 'Confirm', 'Continue'.	**L**
5	An empty ILS could be successfully published without warning or error message.	The system should alert the user about the fact that an ILS is empty.	**H**
6	It is confusing to the user to be sent to the Go-Lab sharing platform without much explanation of the reasons for this change.	Having the entire process contained on the same site. Or give a better explanation of the difference between authoring and publishing.	**M**
7	The sequence of interactions is unexpected and can lead to accidental submission for review (e.g. if the user thinks the ILS is only submitted after filling in the complete form and saving it. Users might want to try out the publishing process, thinking that their ILS will only be published once completing the process, not directly after clicking on the button initiating the process).	Forms should be presented and completed before being able to publish an ILS.	**H**
8	Preview image for the ILS is not mandatory, which means the ILS could end up with an empty space instead of a preview.	Making this field required.	**M**

	Usability Observation	Recommended Modification	Import-ance
9	The button for file uploading is repetitive. 'Submit' is selected as a default button for many different types of actions. 	The button should say 'Upload', 'Continue'.	**L**
10	There is an overwhelming amount of text formats and options.	Reconsider which text formatting options are really necessary.	**L**
11	Disable rich-text and text format seem to be superfluous and possibly confusing (they seem to do the same although there are some differences). 	Simplify the text-edition capabilities. Do not give extra attention to those options. (e.g. size and colours of the text)	**L**
12	Form layout differs from Go-Lab sharing platform layout and correspondence is not always obvious.	A preview button could be useful to compare input with result.	**M**
13	It is not obvious, that you have to click on the tiny dot in front of the existing owner to add more owners. 	Add description of interaction to the explanation for the text field. Or separate them by commas.	**L**
14	Button to add more owners should not be labelled 'Add another item'. 	Label should be 'Add another owner'.	**L**

	Usability Observation	Recommended Modification	Import-ance
15	The functionality to hide/show row weights and prioritize based on them seems to be unnecessary and it does not work very well (numbers are not fully visible).	Remove this functionality.	**L**
16	The process of adding new ILS owners seems to be overly complicated and does not work very well (e.g. you cannot delete ILS owners from the list).	Use the same functionality as for adding several keywords.	**M**
17	Entries in language selection list are not completely alphabetical (first 4).	List should be in alphabetical order.	**L**
18	It is not clear how to select several entries for the language selection.	A description of the shortcuts should be given in the description text. Revaluate if an ILS can be available in more than one language.	**L**
19	Not sure why there is a –None- entry in the language list.	Remove it if not needed.	**L**
20	Entries in the Access rights dropdown are not self-evident and there is no help facility.	Guidance and help or better descriptions are needed to select the appropriate entry.	**H**
21	There is a circle at the end of the keyword input box that seems to have no functionality. Users might get confused about what it might do. 	Remove this circle.	**L**
22	Preview functionality appears unexpectedly on save. It would be nice to have it on demand.	Activate preview functionality right from the start.	**M**
23	Preview is in pink. 	Preview should be an accurate representation of what the Go-Lab sharing platform page will look like.	**L**

	Usability Observation	Recommended Modification	Import-ance
24	Interface element to expand dropdown looks like a 'scroll sideways scrollbar'. 	Change the visual.	**M**
25	In the Subject domain dropdown, if you click on the dropdown triangle that shows the list entries, the triangles to navigate to the sub-topics are not visible. 	Add those triangles to the dropdown entries. Or show the entries in the dropdown in a tree structure. Or show the dropdown list in the 'already expanded' mode.	**L**
26	Age ranges are not appropriate for ILSs, teachers might want to be more specific (e.g. 10-12 includes a school change at age 11 in some countries).	Show an array of tickboxes for each age to select from (e.g. <6, 6, 7, 8, …).	**M**
27	Description 'Level of interaction' is misleading. It seems to be concerned with the amount of interpersonal interaction or interactivity of the apps and labs in the ILS rather than experimental freedom.	Change metadata title to match the content 'experimental freedom'.	**M**
28	Scenario input field has more formatting options than necessary.	Simplify the text-edition capabilities.	**L**
29	It is not obvious why some of the text boxes have extensive editing options (e.g. 'Organisational requirements') and others don't (e.g. 'Students' prior knowledge').	Consistent use of text boxes with appropriate amount of formatting options.	**M**

	Usability Observation	Recommended Modification	Import-ance
30	It is unclear what 'Additional supportive materials' is for. If it is for material for students, that material should be in the ILS, if it is additional information for teachers, the description is wrong. 	Clarify the value and purpose of this meta data field.	**M**
31	Again, row weights to order materials does not make sense.	Remove this confusing and not needed functionality.	**L**
32	The description of 'Cognitive objectives: types of knowledge' talks about 'lab'.	Should be 'ILS' instead. Improvement suggestion for the whole description: 'An ILS could address more than one type of knowledge.'	**L**
33	The description of 'Psychomotor objectives' talks about 'lab'.	Should be 'ILS' instead.	**L**
34	'Educational objective' input field shows a message that it will be removed. The red hint could be perceived as an error message, due to its colour coding. 	Remove it instead or at least hide it from end-users.	**M**
35	Big ideas page does not look very attractive. 	Highlight the key words in each description using bold. Add the icons used everywhere else on the Go-Lab sharing platform for the different big ideas.	**L**
36	Preview does not show the screenshots. That can lead to teachers thinking adding screenshots did not work or it was not saved successfully.	Add screenshots to the preview page.	**H**
37	Not the whole Edit tab on top of the form is a clickable mouse target.	Make the whole tab responsive.	**H**

The overall assessment derived from these results is presented in Section 7.4.6.

VV. Observer Notes on ILS Publishing Process Gathered at Twilight Session for Teacher Trainers (LEIC-13062017)

The following observer notes were taken from observing the participants going through the ILS submission process:

- Participant could easily identify the “Submit inquiry space” button to start the process.
- Pop-Up message in Graasp authoring environment makes sense and is easy to understand.
- The process (green button onwards) is not clear. Participants feel that there is a weird sequence flow and that they should not be allowed to publish before adding all the required information. Acceptance should be the last step.
- Text format is unnecessary. “As a teacher why would you ever want plain text [option to specify detailed descriptions]?” => Remove “WYSIWYG/Plain text” dropdown
- “ILS image” was first overlooked
- “Select media” is a misleading label, should use the word "icon" or say “Add ILS image” instead. Tiny text with explanation is not read therefore having a self-explanatory button label would improve usability. Participants also suggested the addition of predefined images to the search, but would need to follow copyright laws.
- Typo in description of “Advanced” in “Level of difficulty”
- “Level of difficulty” is too general. “Level of independence” or age range would work better.
  Scale should be:
  - All
  - Most
  - Some

  … students can
- “Level of interaction” is misleading and unclear again. It should be renamed to “Level of challenge” for instance.
- For “Average learning time":
  - Didactic hour is complicating it => get rid of it
  - Use minutes for the duration instead => also more flexible
- Edit tab/link is a problem. Difficult to use after saving, from the preview is difficult to go back to edit.
- For the 'big ideas' concept, specific topics could be difficult to fit in these options, but it is good that ticking one box is not mandatory.
- The final results are very well received but the process is long and confusing at some points.
- Not all teachers are interested in cognitive skills needs, therefore some information seems unnecessary and too difficult to fill.
- Far too much information to specify: Unless the teachers are computer-buff once they reach Psychomotor objectives they would have “lost the will to live”.

The overall assessment derived from these results is presented in Section 7.4.6.

WW. Booklet Feedback Gathered on the New ILS Publishing Functionality During the Next-Lab Summer School 2017 (LEIC-11072017c)

Finalised ILS created by the teacher in the Graasp authoring environment:

✓

Clear and perfect ✓

It is very clear and it is easy to follow the process

I found few changes. / I don't know about the peer-to-peer sync.

-

-

-

-

-

ILS submission dialog in Graasp authoring environment:

✓

✓

-

-

-

People that publish should already know this. Give this hint at the Standalone new button.

When I republish ILS I don't want to fill all again.

-

-

Confirmation dialog in Graasp:

✓

✓

-

-

-

-

-

-

-

General Information and Title in the old (left) and new (right) Publishing pages:

It's blue / that's good.

Easy and clear ✓

-

-

The new interface has a more friendly interface than the old one.

-

-

-

No problem. It still looks the same. I had no problem before.

Description input text area for the ILS:

The text editor is complete. It's good, I know about basic HTML.

✓

-

-

I think that there is not too much difference between the old and new. Both of them are comfortable to use in my opinion.

-

-

We need superscript and upperscript option. / It would be useful to be able to use copy-paste technic to add the description from different format types. / There is a need to have all the tools of a word processor.

I prefer the old one because description options is larger.

ILS general settings and rights:

It's clear, all things.

✓ (about the Licence, CC BY-NC) is this possible when you use video + image from youtube…?

-

-

I like the new one. / Maybe the option that the author will do a process alone without administrator is much more comfortable.

-

-

✓ (Strike through: No keywords? They help the selection)

Introduce OWNER is important.

Technical Information and Keywords:

Selection should be from a list. Maybe with more keywords. / It's good.

✓ Is this important?

-

Works offline: it is very useful for schools when the WIFI connection may be weak. What is the operating system needed to download it and make it work offline? Is it suitable for PC or tablet?

✓

-

-

✓

What is works offline?

ILS Subject Domains selection:

New style of domain with subdomain takes too much space. The old one was better/very good.

✓

-

-

I like more the old interface. It has less information, but better 190isualization interface.

-

I think that there is too many options (remove 3rd level and use the filter with keywords).

✓

Developed contents are easier to complete educational options.

Age range classification:

Both first and second are very good.

✓

-

-

✓

-

-

To be able to choose more than one option.

Really we could select more than one? / It's important the possibility to mark simultaneously.

Average Learning Time and Knowledge Requirements:

Very good.

✓

-

-

✓

-

-

About the knowledge requirements: it should not be mandatory. About the average learning time: To have the option for not formal education (out of school, after school, extra-school activities).

About the ‘Average Learning Time’: For multiple age group selection, there must also be multiple average learning time in order to crossmatch it. Average could be longer for higher levels and shorter for lower levels. Teacher will adapt timing (primary, secondary, high) and probably the window could offer this information. About the ‘Knowledge Requirements’: More didactic.

Big Ideas of Science:

Maybe more big ideas of science.

-

-

-

✓

Better. It’s like the new one has less information but has very useful interface.

I think the old one is better because of the context.

-

The option to check more than one big ideas.

Option Educational: Have you deleted definitively “objectives”? / Better new version.

Authoring Information:

Good.

-

-

-

-

When publishing, we should not have to fulfil all the fields again.

-

I would like to be in control with my published ILSs and have the option to delete a particular one. About the author: +Full name.

Better this option.

The overall assessment derived from these results is presented in Section 7.4.6.

XX. Detailed Results of the Go-Lab Support/Help Services Questionnaire with Pre-service Teachers after Face-to-face Training (LEIC-23032017)

The detailed results of the Go-Lab Support/Help Services questionnaire with pre-service teachers after face-to-face training presented in this appendix have been provided by UCY, who performed the related activities leading to the gathering of these data.

Services

a) Live discussion with a Go-Lab team member in person

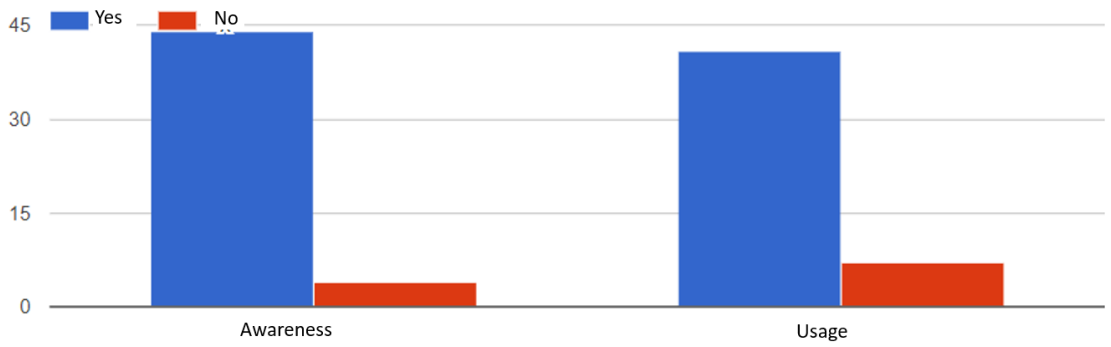


Figure 51. Awareness and usage (number of responses on y-axis)

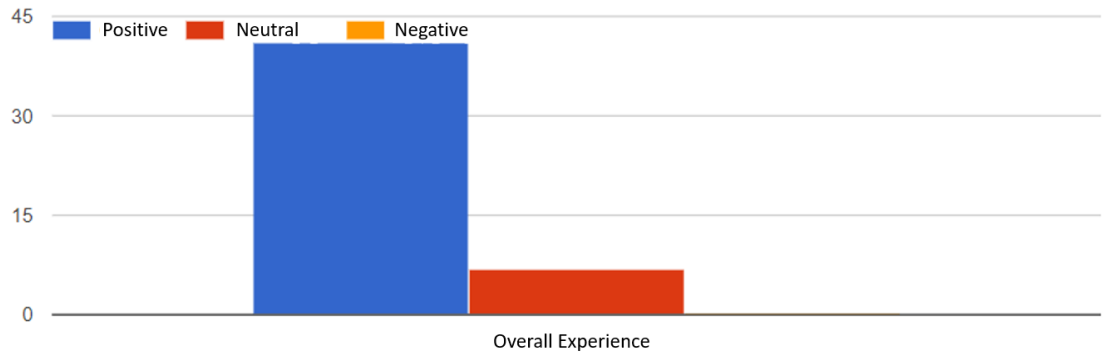


Figure 52. Overall experience

Improvement suggestions: (4 answers)

- It would be nice if more labs translated in Greek so that to have more options with more specificity.
- Offer a kind of feedback to user in order to use it independently.
- I don't have any suggestion.
- More discussions for update.

b) Live video discussion with a Go-Lab team member in the Tutoring Platform (http://tutoring.golabz.eu)

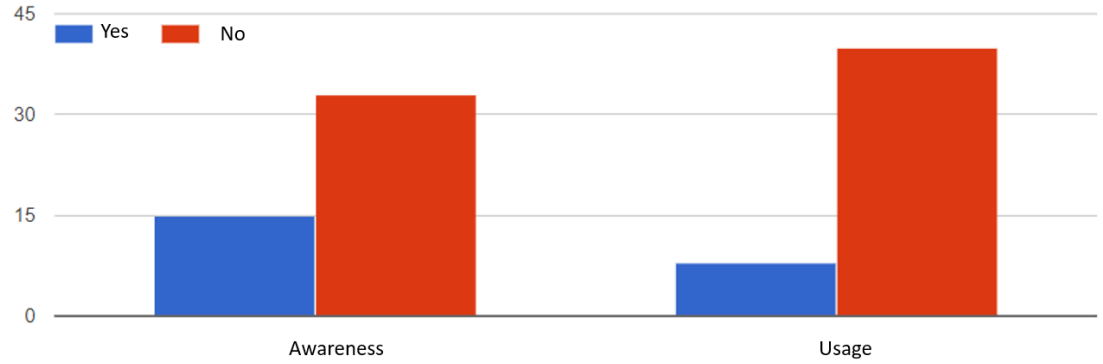


Figure 53. Awareness and usage

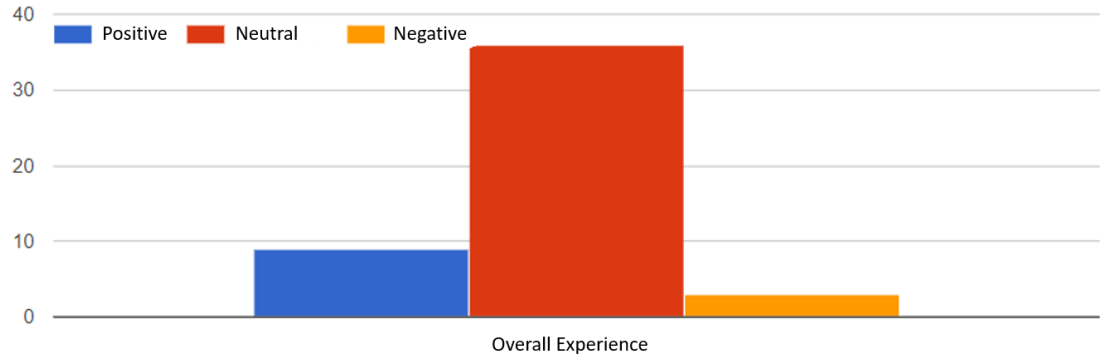


Figure 54. Overall experience

Improvements suggestions: (1 answer)

- I have never used the live discussion.

c) Emailing a Go-Lab team member

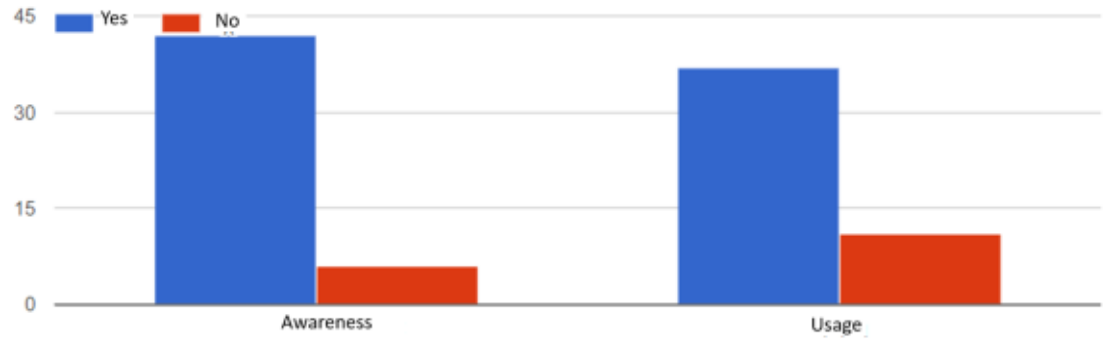


Figure 55. Awareness and usage

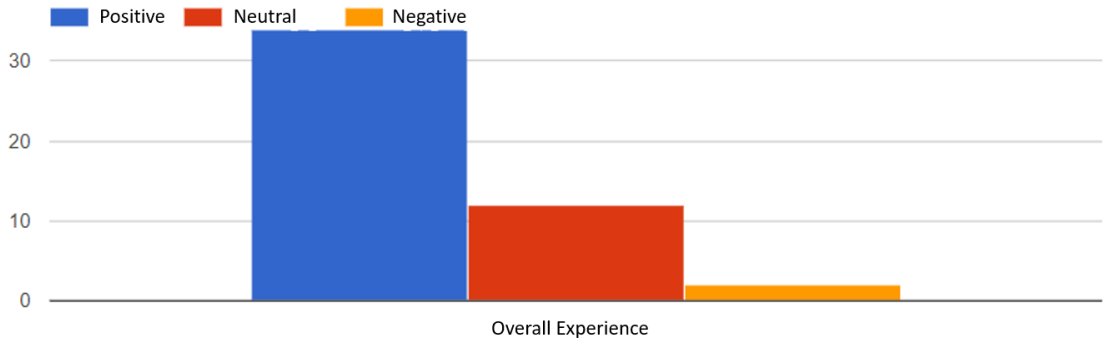


Figure 56. Overall experience

Improvement suggestions: (1 answer)

- Give as much as possible faster feedback

d) Direct contact with a lab owner (e.g. through email or forum on the details page of a lab, see the bottom of http://www.golabz.eu/lab/electrical-circuit-lab for example)

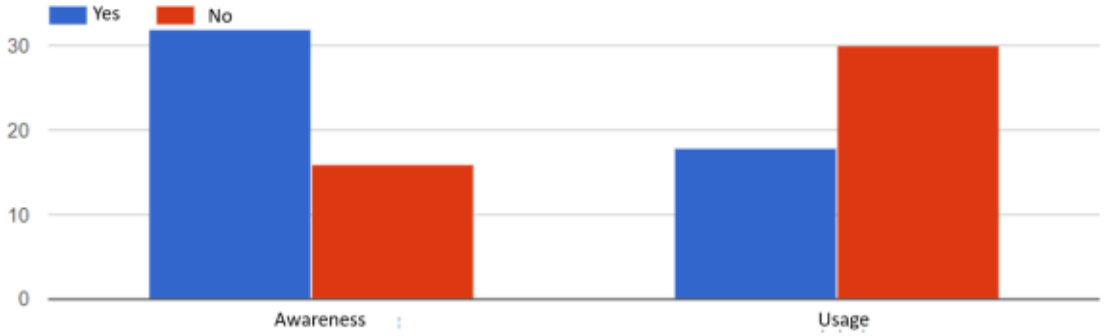


Figure 57. Awareness and usage

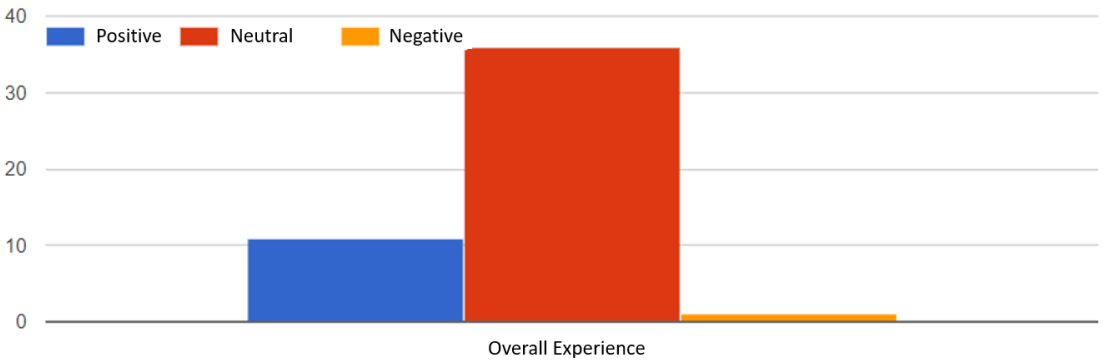


Figure 58. Overall experience

Improvement suggestions: (2 answers)

- I don't know how this works.
- It would be nice to do this inside the lab.

e) Direct contact with an app developer (e.g. through email or forum on details page of app, see bottom of http://www.golabz.eu/app/hypothesis-tool for example)

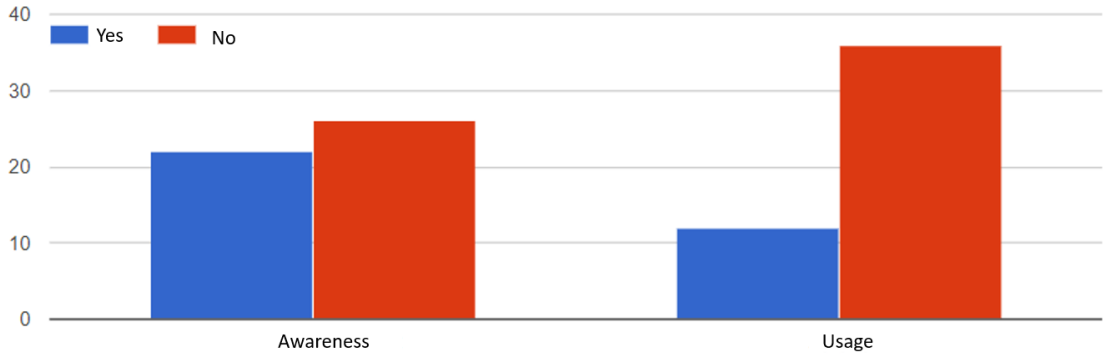


Figure 59. Awareness and usage

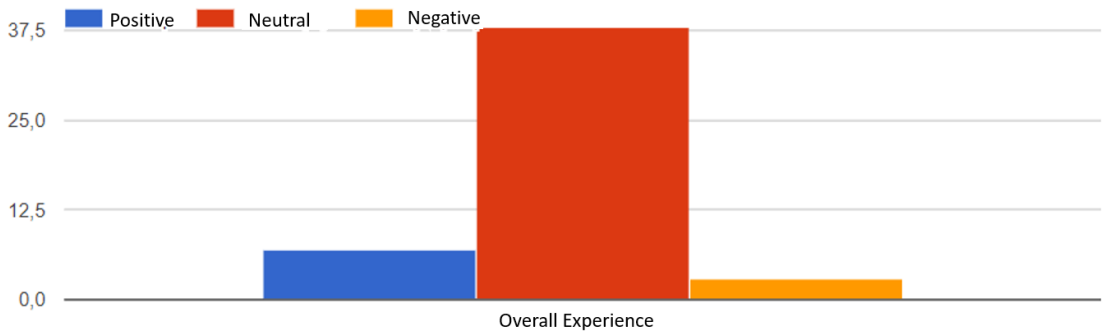


Figure 60. Overall experience

Improvement suggestions: (1 answer)

- I don't know how this works.

f) Direct contact with ILS creator (e.g. through email or forum on the details page of an ILS, see bottom of http://www.golabz.eu/spaces/color-light for example)

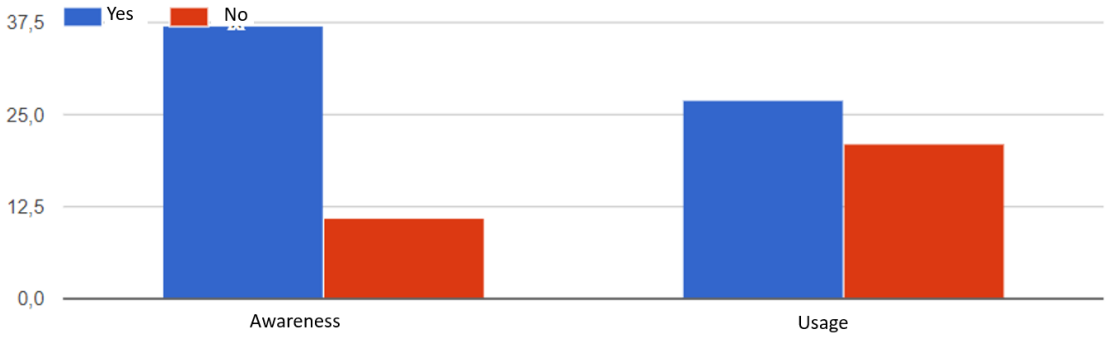


Figure 61. Awareness and usage

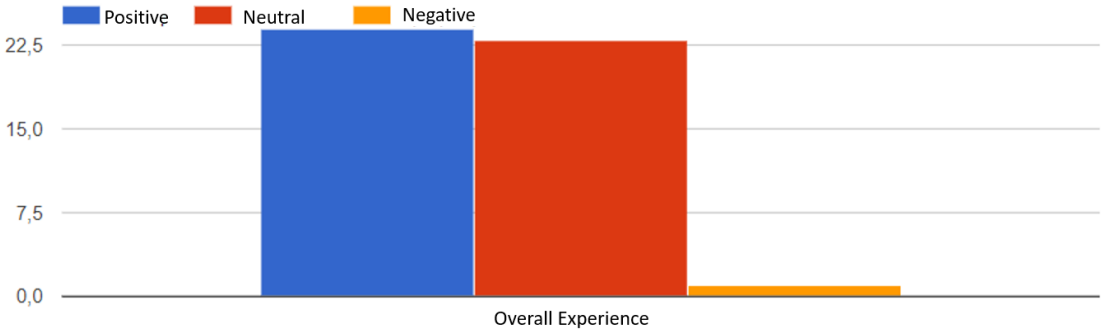


Figure 62. Overall experience

Improvement suggestions: (1 answer)

- I think it does not need any improvement

g) Community forum in the Tutoring Platform (http://tutoring.golabz.eu/forum)

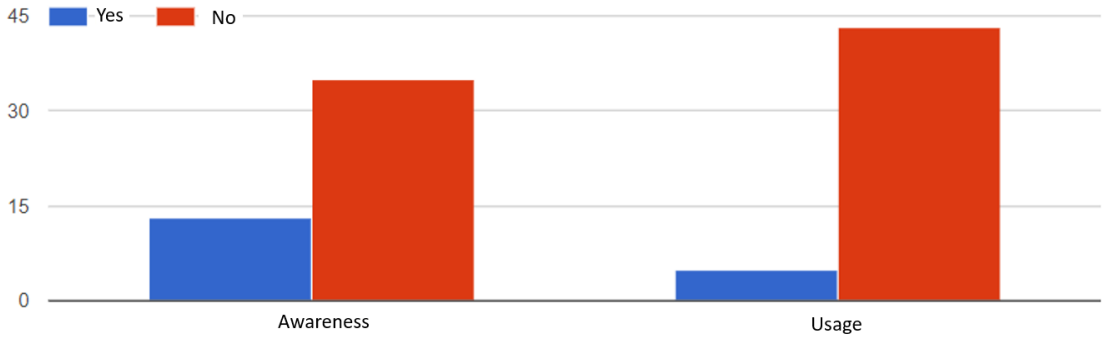


Figure 63. Awareness and usage

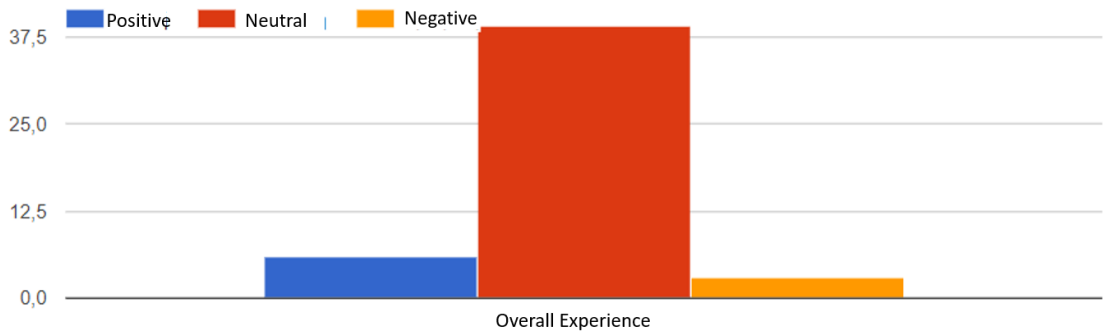


Figure 64. Overall experience

Improvement suggestions: (1 answer)

- I don't know how this works.

h) Forum for improvement suggestions (https://graasp.uservoice.com/forums/108675-graasp-feedback)

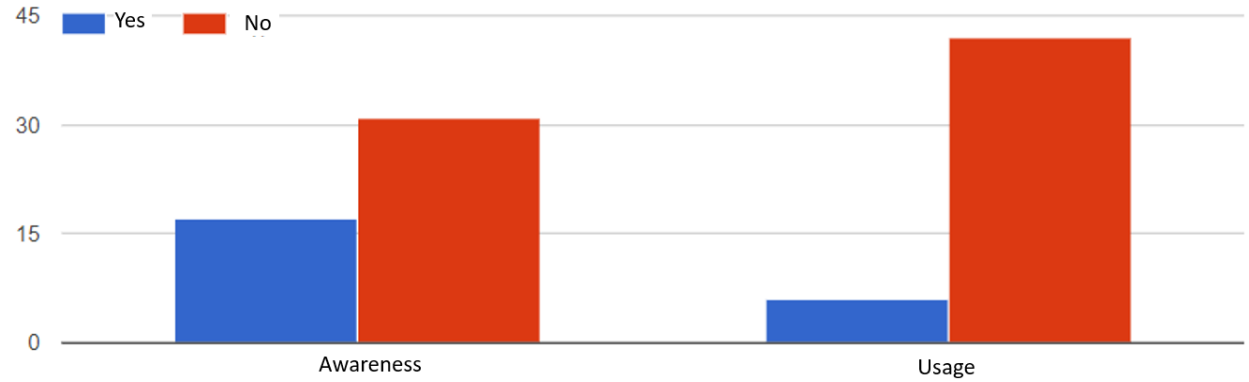


Figure 65. Awareness and usage

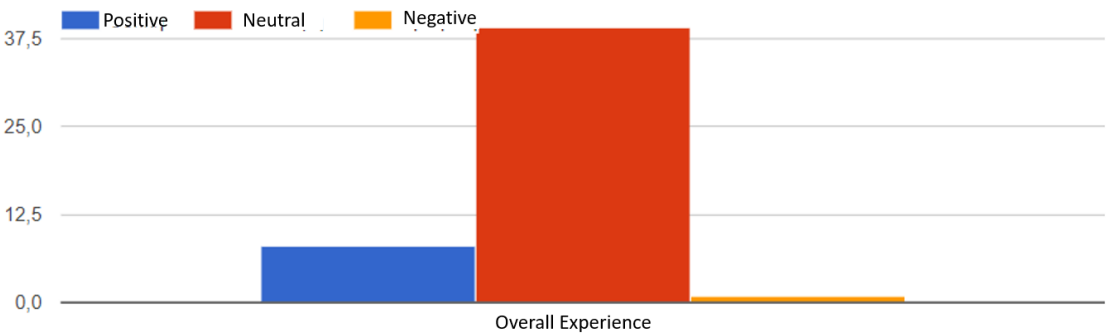


Figure 66. Overall experience

Improvements suggestions: (1 answer)

- I don't know how this works.

i) Online course (MOOC) on opencourseworld

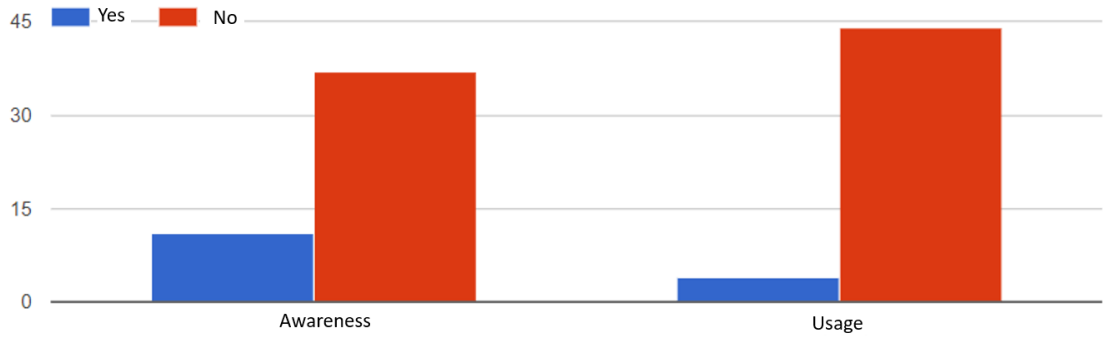


Figure 67. Awareness and usage

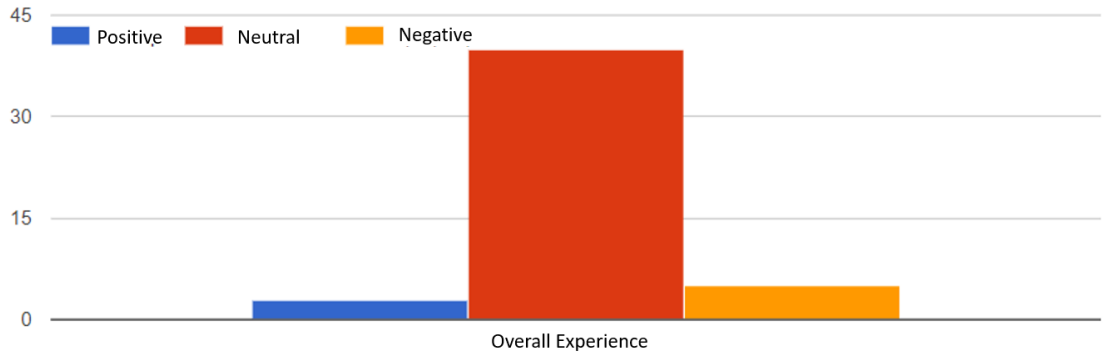


Figure 68. Overall experience

Improvement suggestions: (1 answer)

- I think it does not need any improvement.

j) Video tutorials on the Go-Labz portal (http://www.golabz.eu/videos)

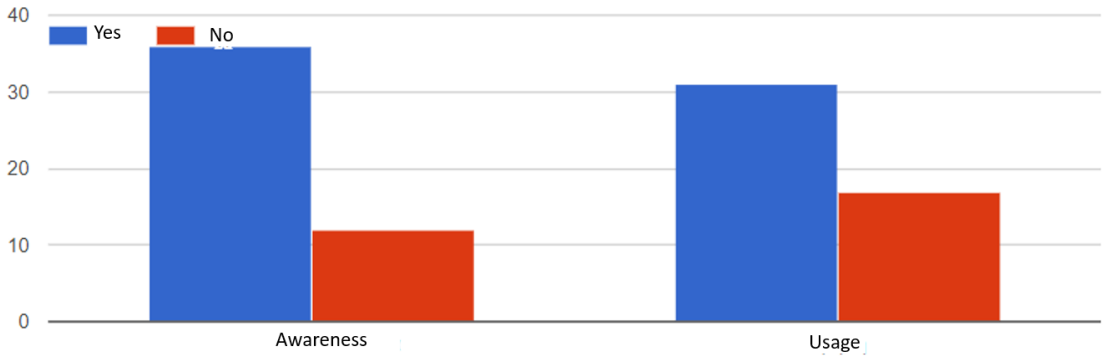


Figure 69. Awareness and usage.

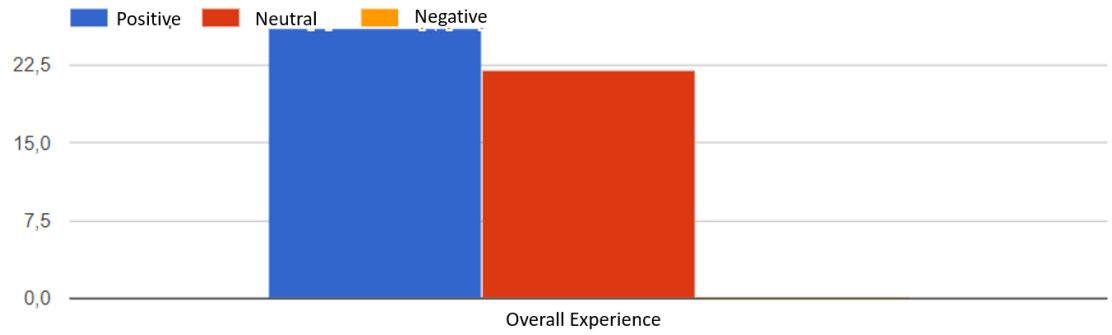


Figure 70. Overall experience

Improvement suggestions: (1 answer)

- They might be available with subtitles.

k) Questions & Answers / FAQ (Frequently Asked Questions) section of the Go-Lab homepage(http://go-lab-project.eu/faq-new-page)

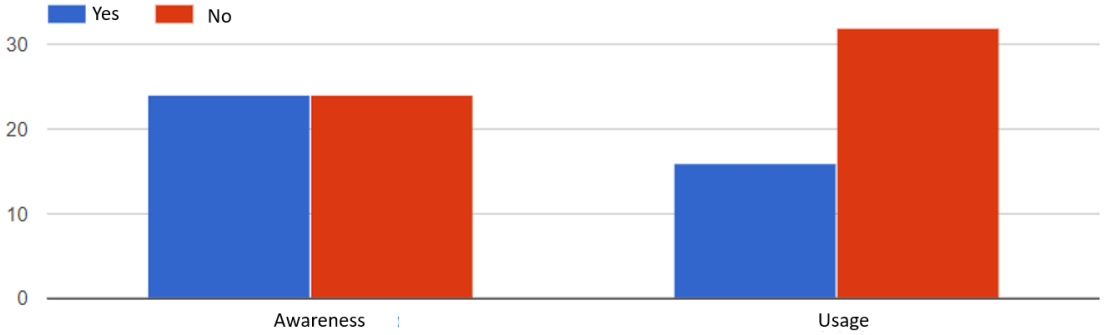


Figure 71. Awareness and usage

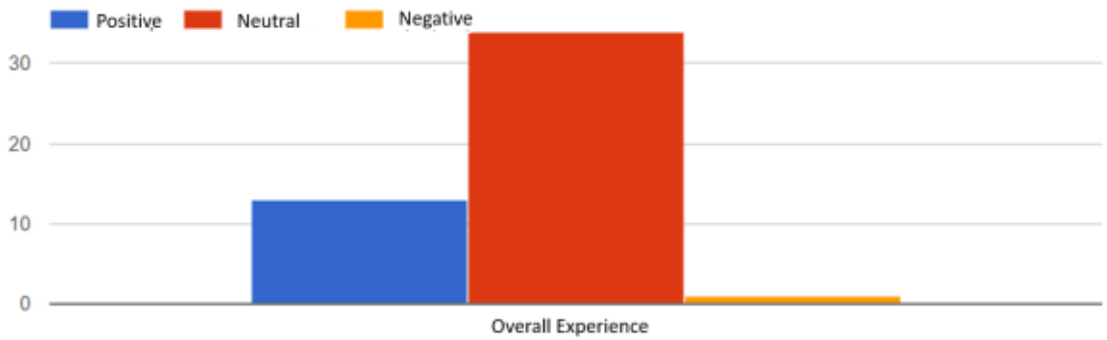


Figure 72. Overall experience

Improvement suggestions: (1 answer)

- I don't know how this works since I haven't used it yet.

l) Tips & Tricks tutorials on the Go-Lab homepage (http://go-lab-project.eu/tps-tricks)

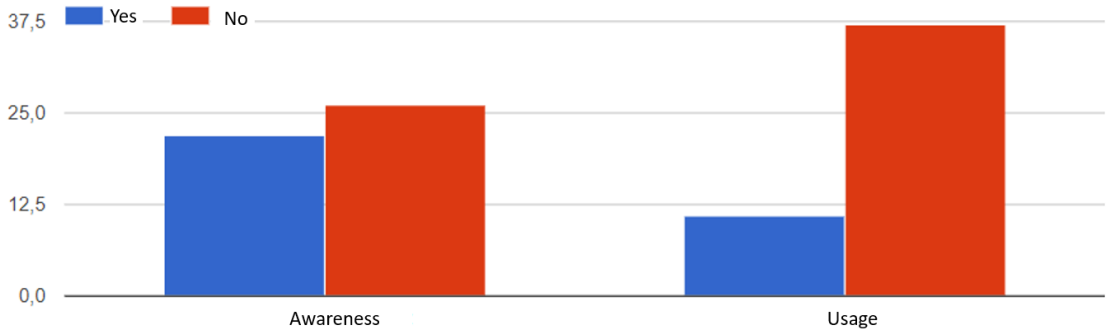


Figure 73. Awareness and usage

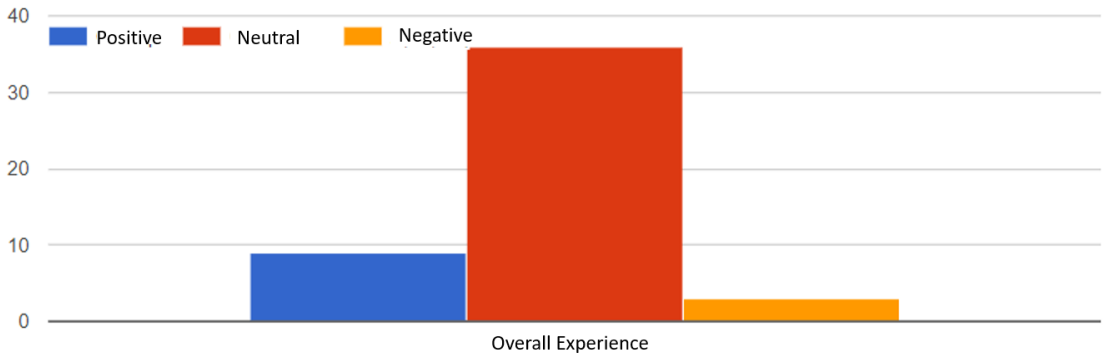


Figure 74. Overall experience

Improvement suggestions: (1 answer)

- I don't know how this works.

m) User manuals on the Go-Labz portal (http://www.golabz.eu/tutorial/user-manuals)

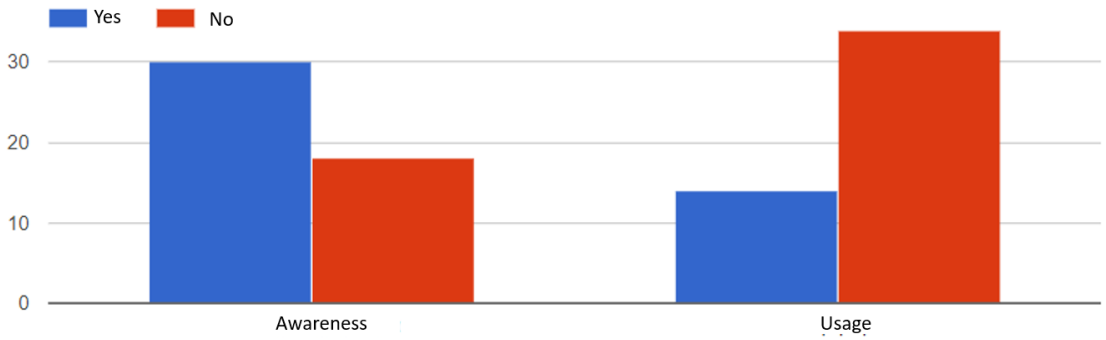


Figure 75. Awareness and usage

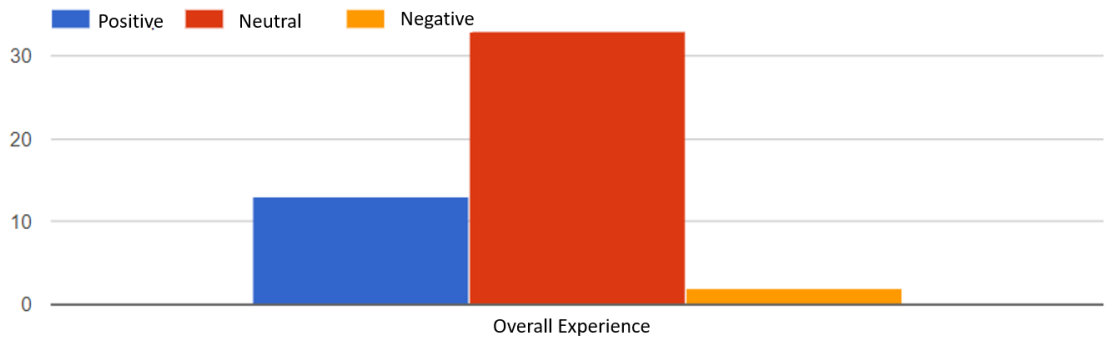


Figure 76. Overall experience

Improvement suggestions: (1 answer)

- The Classroom Scenario handbooks must be offered in Greek. This will be helpful for many users.

Usability problems

a) Have you experienced problems in using Go-Lab artefacts (ILS, apps, labs) and could not resolve the problem, with or without using Go-Lab support/help services?

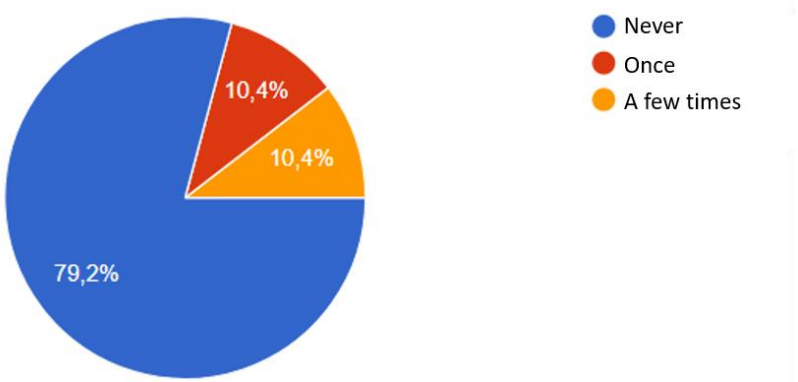


Figure 77. Experience of usability problems that could not be resolved

Please describe the problem if there was any

(11 answers)

- The results didn't show up in the Conclusion tool.
- Problem during the playback of a video – probably it was a problem of active memory.
- Many apps did not load normally, and I had to refresh several times.
- Sometimes graap didn't work as it should.
- Graph creation and automatic delete of the data I entered.
- There are no undo and redo options. The platform stucks when many users are connected.

- When everyone was connected to the Go-Lab, it was slower. Also, when someone clicks refresh and previously did not close an application, will lose the configuration.
- When using Internet explorer, the data graph was not displayed.
- It was blocked (the graasp) and I couldn't add my material.
- The loading is slow and you need to refresh after each change you made.
- Sometimes the program was stuck and in addition there was a problem with the graphs, they didn't show up or even didn't allow me to add the proper variables in the corresponding axes.

b) If solved "with" Go-Lab support, which of the help service(s) did you use? Why did it (they) not work?

(3 answers)

- Communication with a responsible person through email.
- I did not face a problem so that to use any function of the Go-Lab support.
- I did not face a problem so that to use any service of the Go-Lab support.

c) If solved "without" Go-Lab support, why did you not try to use one of the help services?

(4 answers)

- I solved the problem myself.
- I did not face a problem so that to use any service of the Go-Lab support.
- I did not face a problem so that to use any service of the Go-Lab support or any other service.
- I hadn't thought it.

d) What additional support/help services could have helped resolve the problem?

(4 answers)

- Video
- I did not face any problem.
- There has been no need to use the additional services to solve a problem.
- I don't know.

e) If we are going to offer you the following new support/help desk services, please rate their necessity and comment on your choice.

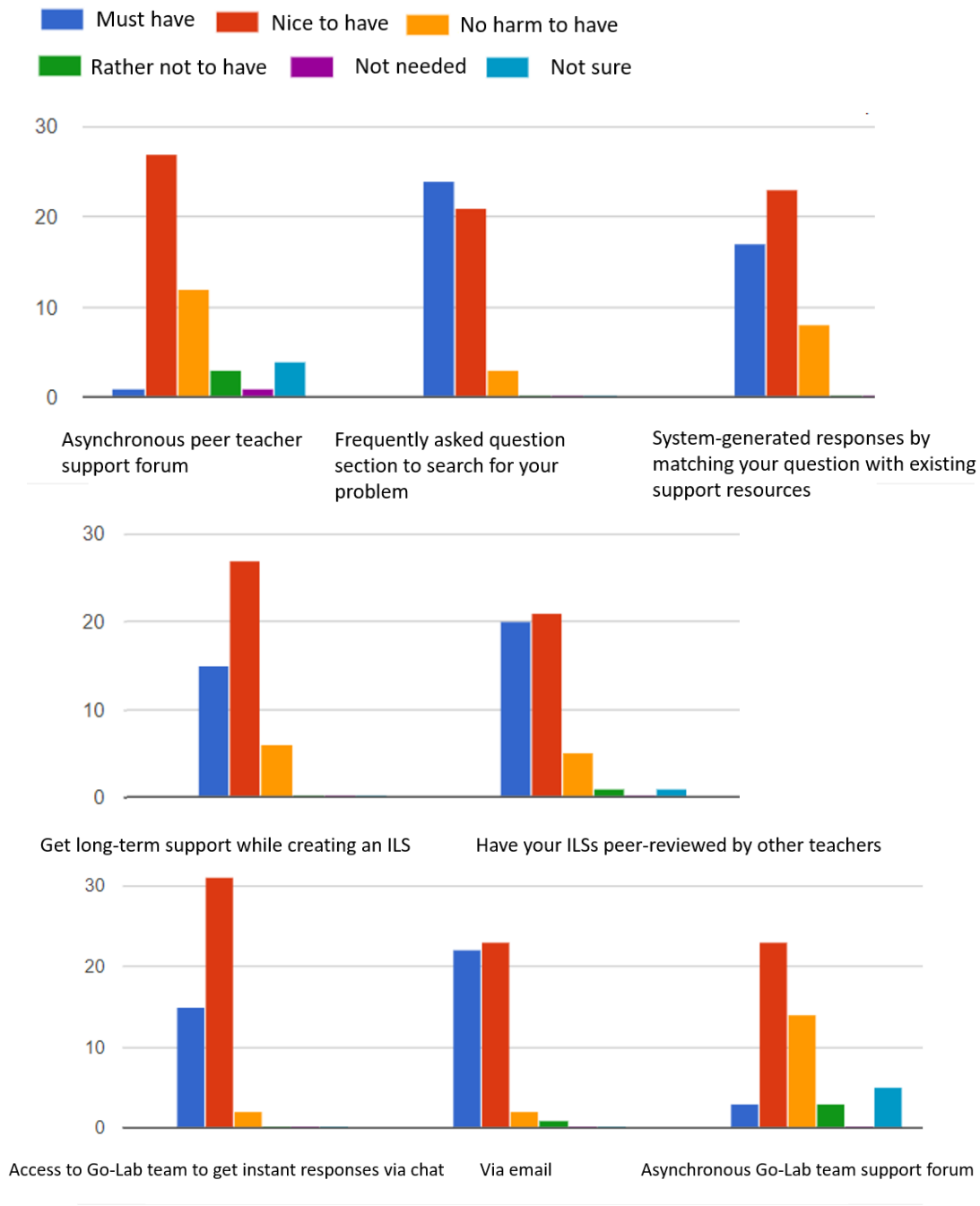


Figure 78. Necessity rating for different proposed new Help and Support Services in Next-Lab

In case you would like a help facility not mentioned in the list above, please specify it here:

(1 answer)

- automatic scientific check of the ILSs during their creation

About you

a) I have used:

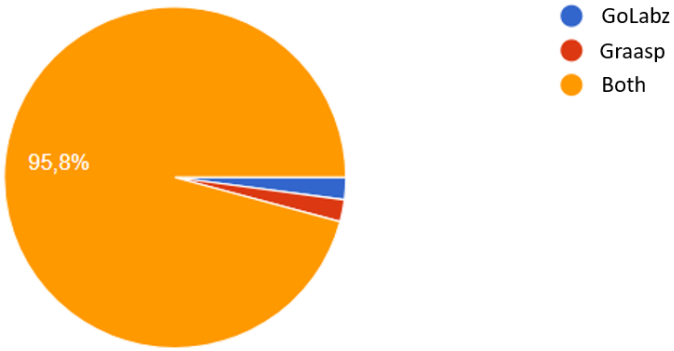


Figure 79. Participant responses regarding the platforms they used

b) How would you describe yourself in terms of your experience of using Go-Lab artefacts and services?

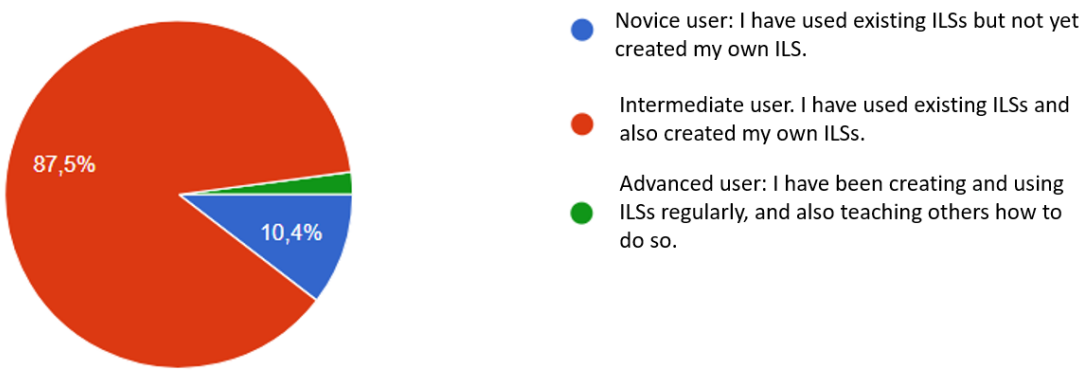


Figure 80. Participant responses regarding their experience with the Go-Lab system

c) Which type of academic institution are you teaching?

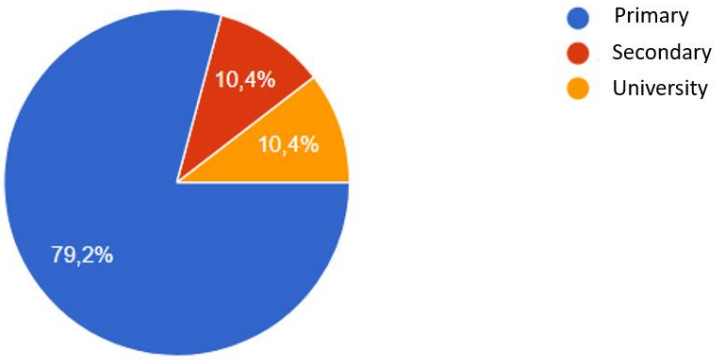


Figure 81. Participant responses regarding the academic institute they are teaching at.

The overall assessment derived from these results is presented in Section 7.4.8.

YY. Detailed Results of the Go-Lab Support/Help Services Questionnaire Including the Responses from the Ambassador Workshop in Brussels (LEIC-06052017a)

There are two sources of information contained in this appendix. One of them being the PD session during the workshop with ambassadors in Brussels, and the second one is an ongoing online questionnaire regarding Help and Support (http://tinyurl.com/NextLab-Help).

The format of the data gathering included:

- For the ambassadors workshop
  - Hands-up questions
  - Demo of each facility on the Go-Lab sharing platform
  - Open discussion
  - Online questionnaire
- For pre-service teachers in Cyprus
  - Online questionnaire

Context:

- So far 65 people have participated in PD activities regarding Help and Support services.
- 80% of them teach in Secondary Institutions (High School); 14% in Elementary Schools (Primary); and only 6% in other educational stages (College or University).
- The proportion of teachers that have experience using both platforms is quite high, at 80%. Out of 65 people, 5 have only used the Go-Lab sharing platform before and 8 have only used Graasp. The remaining 52 have used both platforms regularly.

The main findings are:

- Although the majority of teachers know about both platforms, only 14% consider themselves advanced users, who have not only been creating and using ILSs regularly, but also teaching others how to do so. 17% have created their own ILSs and used existing ones. And the vast majority (69%) classified themselves as novice users, who have only used existing ILSs but not yet created their own.
- Commonly mentioned usability problems that teachers bear while using the platform include: slow connection and loading of some artefacts, frozen screens and lose of data, compatibility issues, constant need of refreshing tabs, and lack of undo or redo buttons. If users were not able to resolve the problem with the help of any Next-Lab Help/Support service, it was due to one of the following reasons: lack of time, they fixed the issue themselves, or they weren't aware of the available services. If teachers solved the problem with the help of Go-Lab support they did it through email, direct contact, workshops, video tutorials or manuals.
- Teachers also suggested that there should be more technical support and video tutorials.
- From the existing Help and Support Services the most used ones are as follows: live discussion with a Go-Lab team member in person at the top of the list with 82% of respondents who used it. Emailing a Go-Lab team member comes in second place with 74% of users contacting experts through this service. Video tutorials are also frequently used by 68% of the participants.

- The services that teachers do not particularly access, or are even aware of, include: online courses (MOOC) with 18%, community forums with 17%, and only 15% of users know about the forum for improvement suggestions.
- When asking the participants to rate the necessity of different Support and Help Services, 29 said that having “access to Go-Lab team to get instant responses via email” is a “must have” and 29 (45%) chose “must have” the “frequently asked question section to search for common problems”. The majority of responents said it would be ‘nice to have’ “access to Go-Lab team via instant chat”, “asynchronous peer teacher support forum”, and “long-term support while creating an ILS”. The remaining options (“having ILSs peer-reviewed by other teachers”, “asynchronous Go-Lab team support forum”, and “system-generated responses by matching questions with existing support resources”) are classified as ‘no harm to have’.
- The less popular options for new Help desk services seem to be the asynchronous communications.
- The use of the proposed Intercom system can facilitate fast response rates and should thus cater for the preference of teachers to get help as instantly as possible.

SURVEY ON NEXT-LAB SUPPORT AND HELP SERVICES

For this survey we tried to gather information about the teachers’ experience of using existing Go-Lab Support/Help Services and their suggestions for improving these services.

A total of 65 answers were received, 17 of which came from the group of ambassadors that attended the Next-Lab Workshop in Brussels on May 2017, and the remaining 48 from our partners in UCY (see Appendix XX). All responses are presented combined here to have all results on this questionnaire in one place. The reason for the separate presentation of the UCY data in Appendix XX is that it has been gathered and reported by the UCY project partner like this.

Services

For each of the following existing Go-Lab support/help services, participants need to indicate whether they know about it (Awareness), have used it (Usage), overall experience, and improvement suggestions.

a) Live discussion with a Go-Lab team member in person

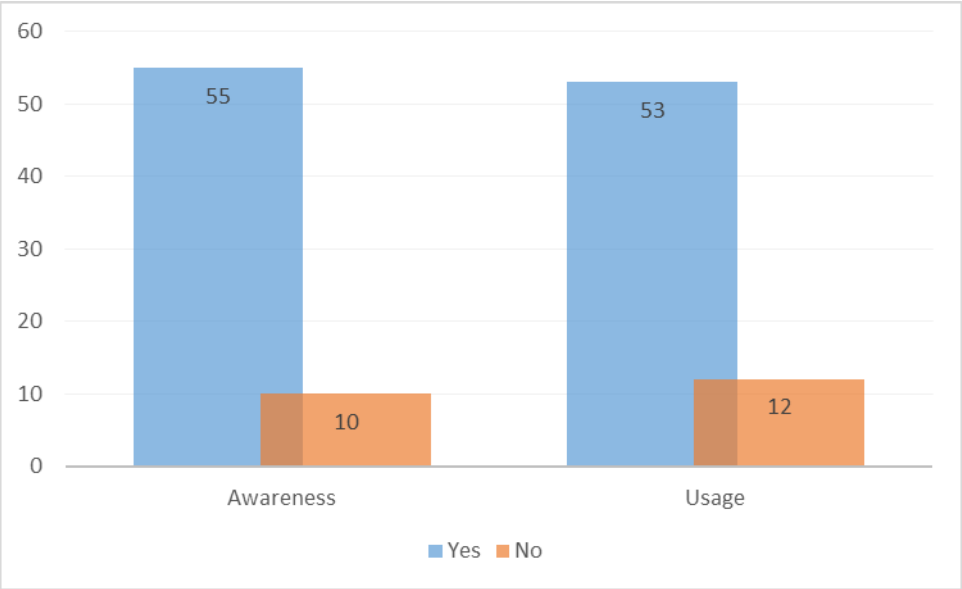


Figure 82. Awareness and usage

Improvement suggestions

- *New to Go-labs so my answers are based on initial interaction with the platform.*
- *It's not necessary, it was very good.*
- *I don't have any suggestion.*
- *More discussions for update.*
- *Offer a kind of feedback to user in order to use it independently.*
- *It would be nice if more labs translated in Greek so that to have more options with more specificity.*

b) Live video discussion with a Go-Lab team member in the Tutoring Platform (http://tutoring.golabz.eu)

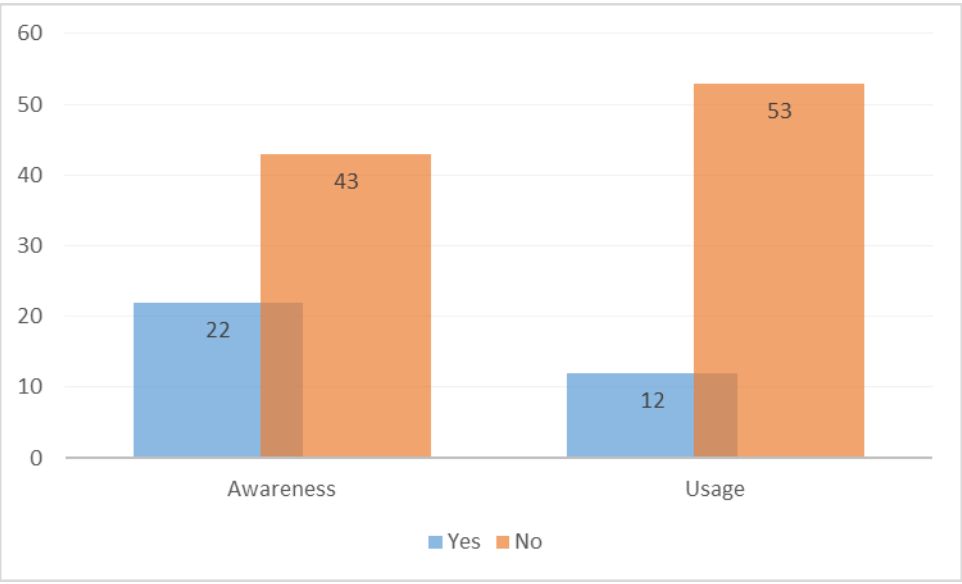


Figure 83. Awareness and usage

Improvement suggestions

- *I have never used the live discussion.*

c) Emailing a Go-Lab team member

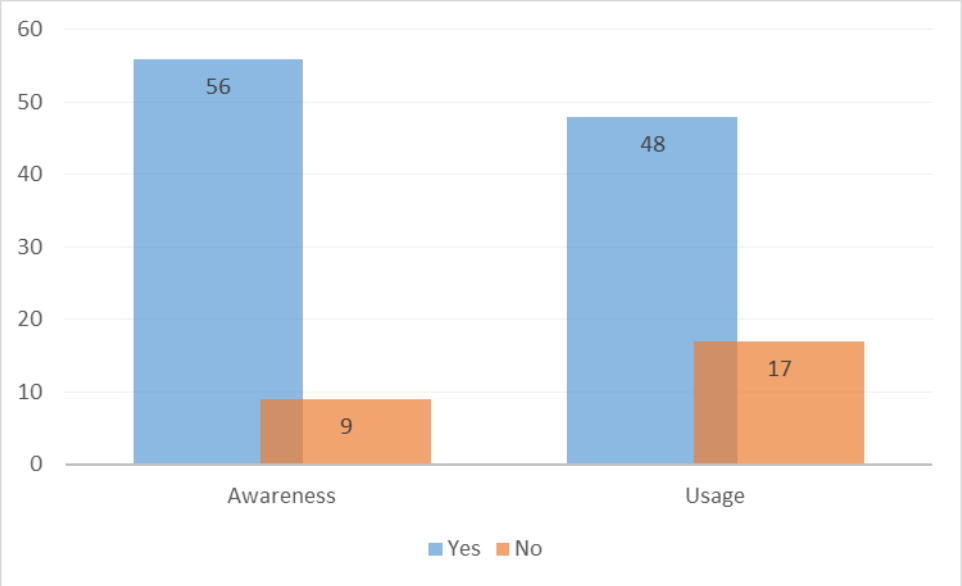


Figure 84. Awareness and usage

Improvement suggestions

- *They are very responsible.*
- *Give as much as possible faster feedback.*

d) Direct contact with a lab owner (e.g. through email or forum on the details page of a lab, see the bottom of http://www.golabz.eu/lab/electrical-circuit-lab for example)

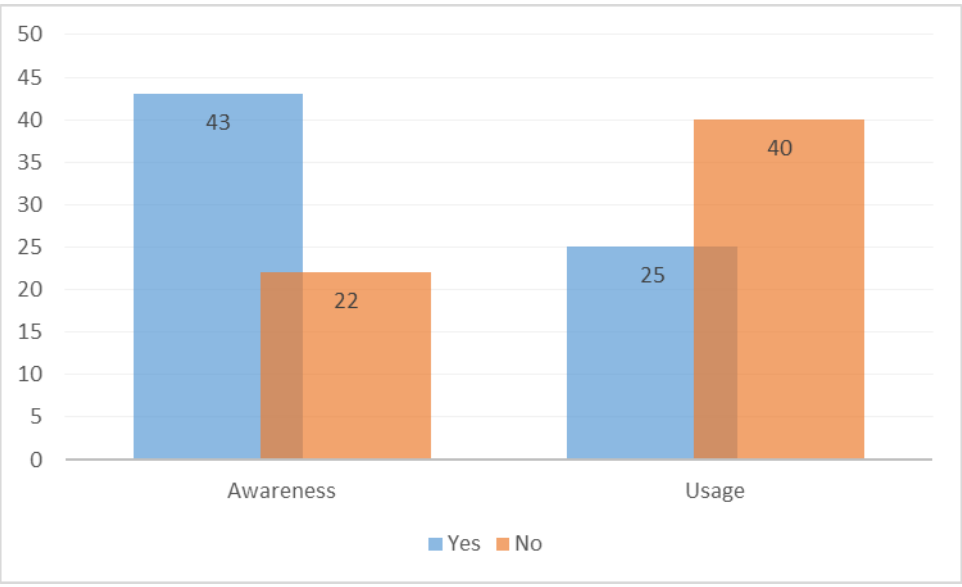


Figure 85. Awareness and usage

Improvement suggestions

- *The lab description in Golabz should be more complete and mandatory. Some labs are, unfortunately, not useful because of this lacking description or a valid description in the ABOUT space.*
- *I don't know how this works.*
- *It would be nice to do this inside the lab.*

e) Direct contact with an app developer (e.g. through email or forum on details page of app, see bottom of http://www.golabz.eu/app/hypothesis-tool for example)

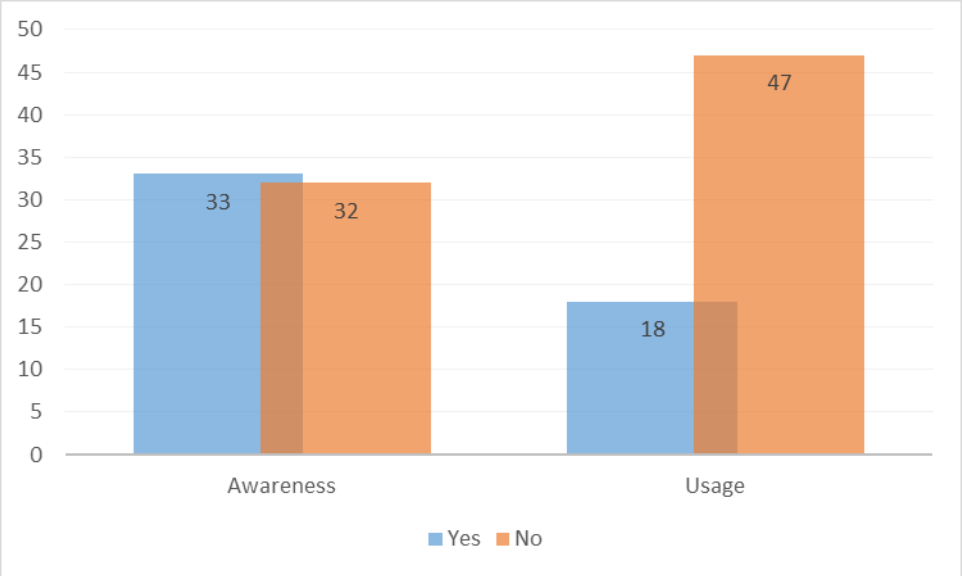


Figure 86. Awareness and usage

Improvement suggestions

- *I don't know how this works*
- *New to Go-labs so my answers are based on initial interaction with the platform.*

f) Direct contact with ILS creator (e.g. through email or forum on the details page of an ILS, see bottom of http://www.golabz.eu/spaces/color-light for example)

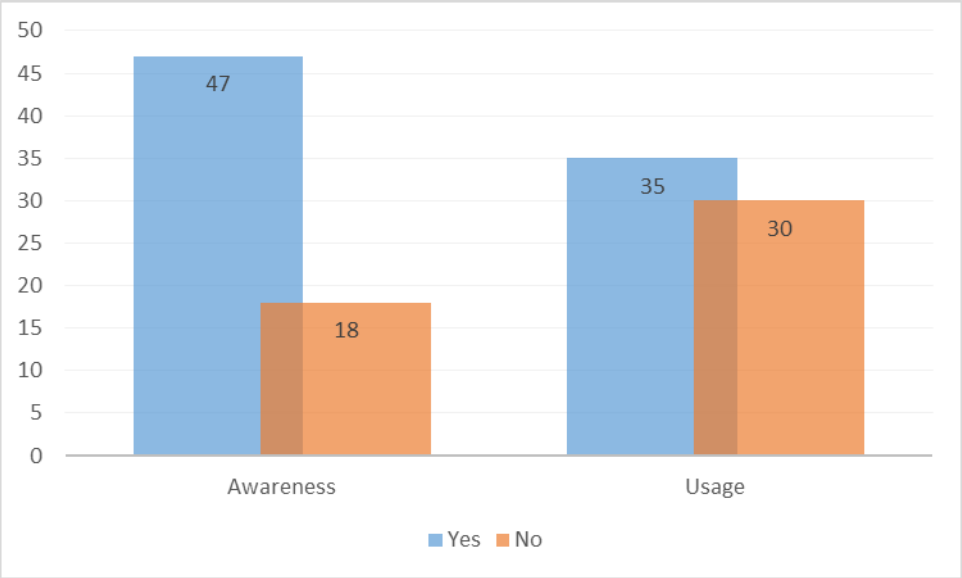


Figure 87. Awareness and usage

Improvement suggestions

- *Collaboration with each other.*
- *I think it does not need any improvement.*

g) Community forum in the Tutoring Platform (http://tutoring.golabz.eu/forum)

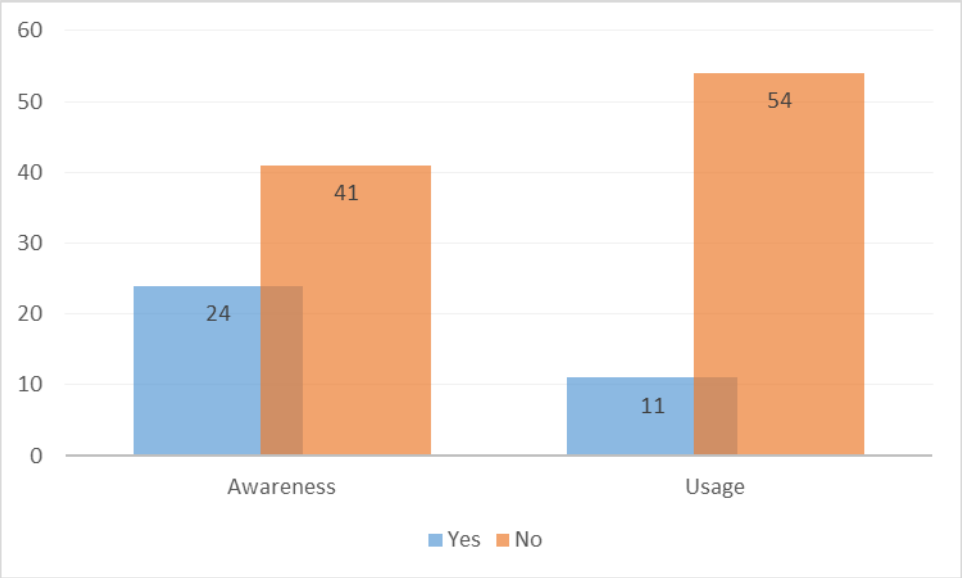


Figure 88. Awareness and usage

Improvement suggestions

- I don't know how this works.

h) Forum for improvement suggestions (https://graasp.uservoice.com/forums/108675-graasp-feedback)

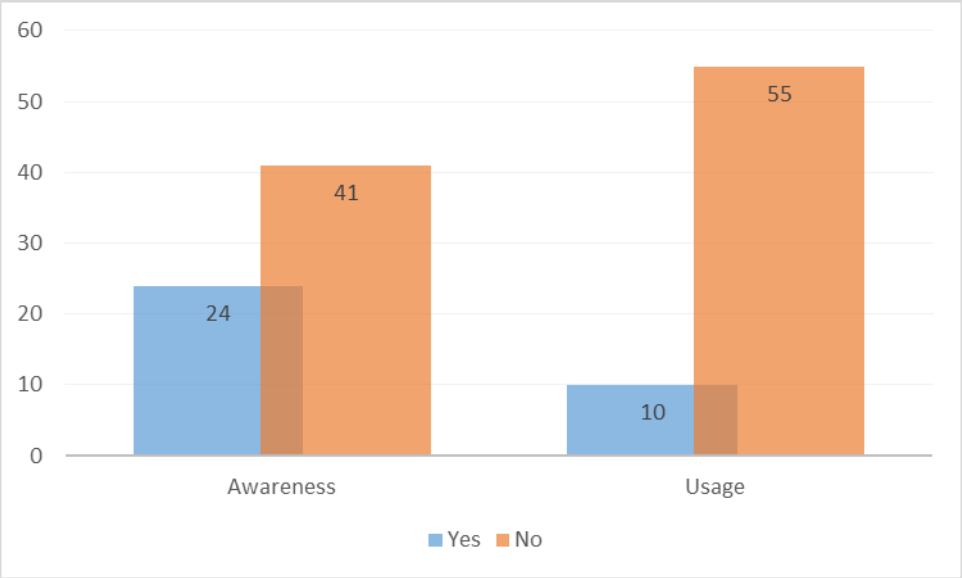


Figure 89. Awareness and usage

Improvement suggestions

- *I don't know how this works.*

i) Online course (MOOC) on opencourseworld

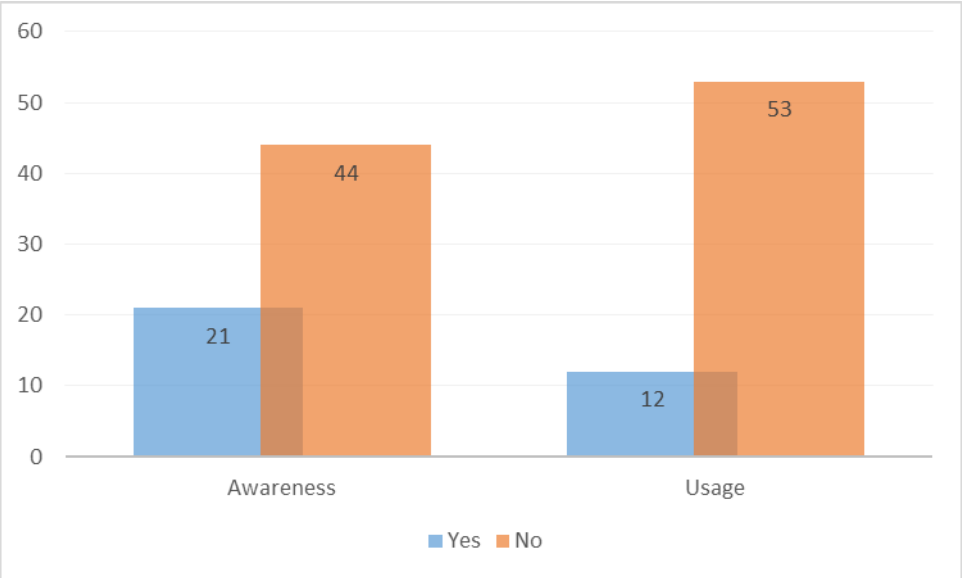


Figure 90. Awareness and usage

Improvement suggestions

- *I think it does not need any improvement.*

j) Video tutorials on the Go-Labz portal (http://www.golabz.eu/videos)

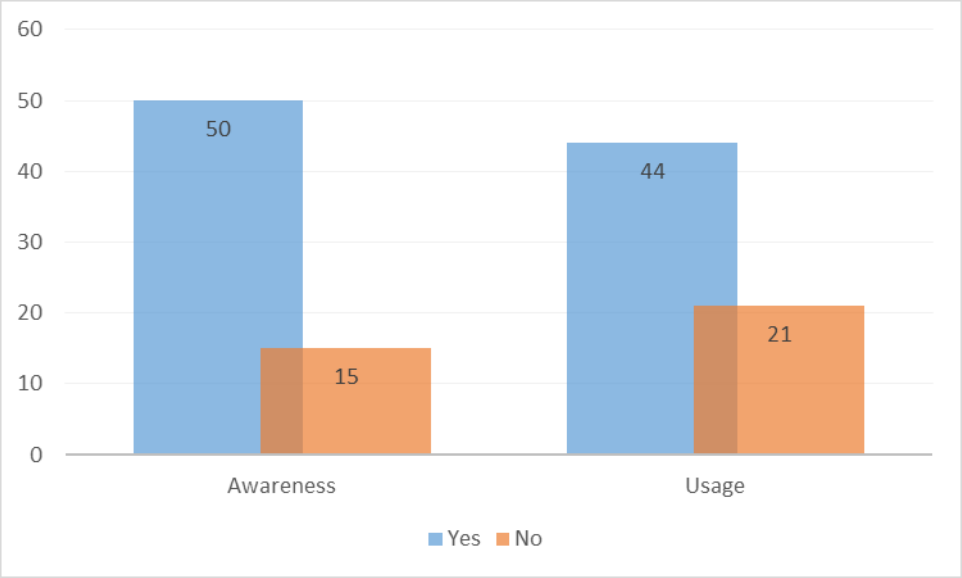


Figure 91. Awareness and usage

Improvement suggestions

- *They could be available with subtitles.*
- *They might be available with subtitles.*

k) Questions & Answers / FAQ (Frequently Asked Questions) section of the Go-Lab homepage(http://www.go-lab-project.eu/faq)

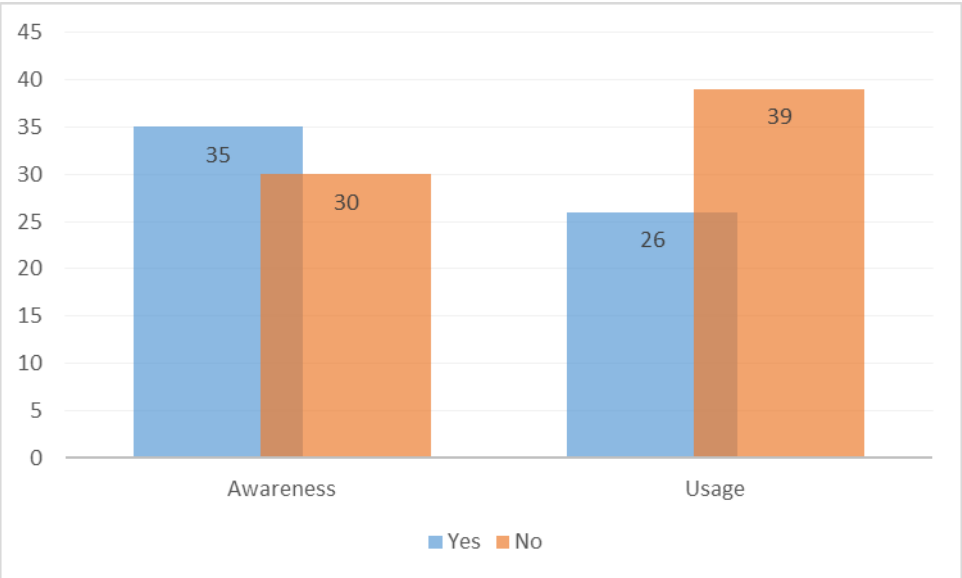


Figure 92. Awareness and usage

Improvement suggestions

- I don't know how this works since I haven't used it yet.

l) Tips & Tricks tutorials on the Go-Lab homepage (http://go-lab-project.eu/tips-and-tricks)

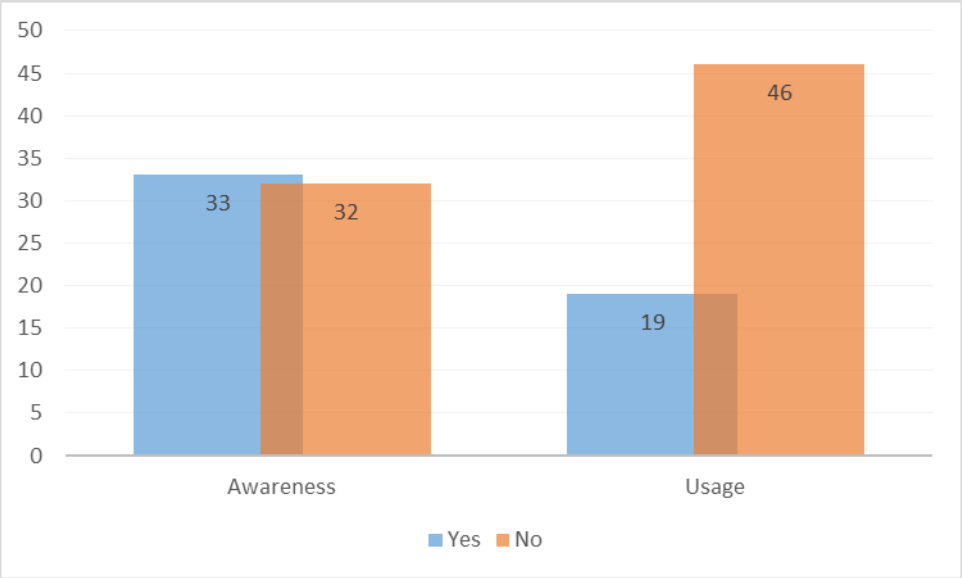


Figure 93. Awareness and usage

Improvement suggestions

- I don't know how this works.

m) User manuals on the Go-Labz portal (http://www.golabz.eu/tutorial/user-manuals)

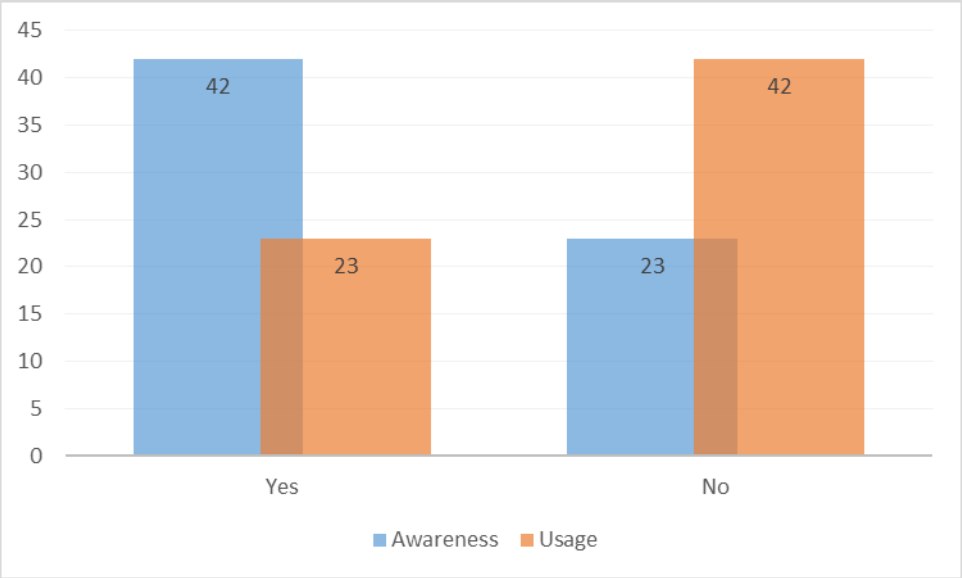


Figure 94. Awareness and usage

Improvement suggestions

- *Note- I answered the above questions re awareness and usage as no as I have yet to discover and learn how to use Go Lab. I used some virtual labs but still need more time to discover all features.*
- *Translate the Manual tutorials in several languages.*
- *The Classroom Scenario handbooks must be offered in Greek. This will be helpful for many users.*

Existing and new help features

a) Have you experienced problems in using Go-Lab artefacts (ILS, apps, labs) and could not resolve the problem, with or without using Go-Lab support/help services?

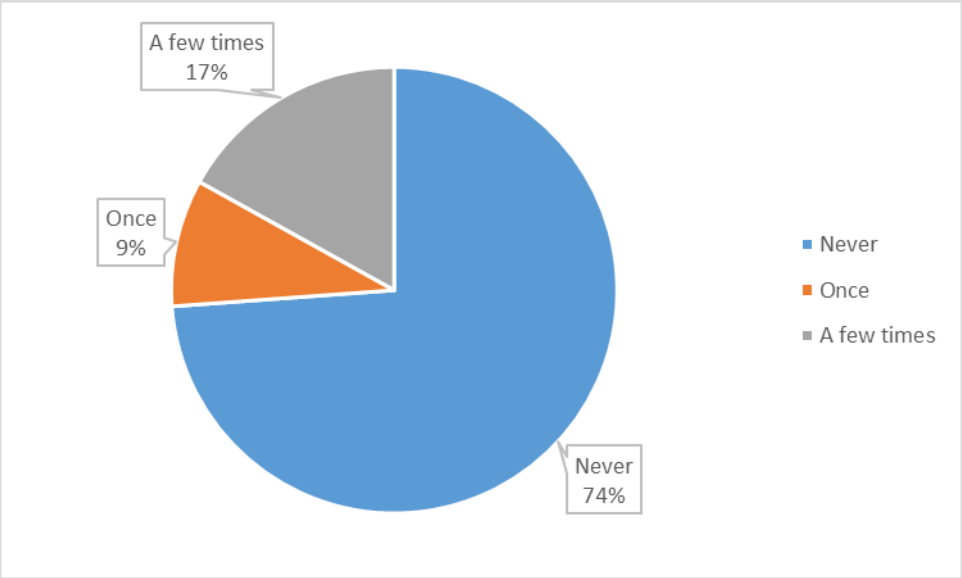


Figure 95. Experience of usability problems that could not be resolved

b) Please describe the problem if there was any.

- *When I used the lab in my class the computers there did not support all features.*
- *I have to spend more time and learn.*
- *Apps did not work in my notebook.*
- *Sometimes the program was stuck and in addition there was a problem with the graphs, they didn't show up or even didn't allow me to add the proper variables in the corresponding axes.*
- *Graph creation and automatic delete of the data I entered.*
- *There are no undo and redo options. The platform freezes when many users are connected.*
- *When everyone was connected to the Go-Lab, it was slower. Also, when someone clicks refresh and previously did not close an application, will lose the configuration.*
- *When using Internet explorer the data graph was not displayed.*
- *It was blocked (Graasp) and I couldn't add my material.*
- *The loading is slow and you need to refresh after each change you made.*

c) If solved "with" Go-Lab support, which of the help service(s) did you use? Why did it (they) not work?

- *Direct contact.*
- *Problem and some questions solved today (during the workshop).*
- *Video tutorials, manuals.*
- *Communication with a responsible person through email.*

d) If solved "without" Go-Lab support, why did you not try to use one of the help services?

- *I wanted to solve it very quickly so I changed the apps.*
- *Lack of Time.*
- *I hadn't thought it.*
- *I solved the problem myself.*

e) What additional support/help services could have helped resolve the problem?

- *Technical support*
- *Videos.*
- *There has been no need to use the additional services to solve a problem.*

f) If we are going to offer you the following new support/help desk services, please rate their necessity and comment on your choice.

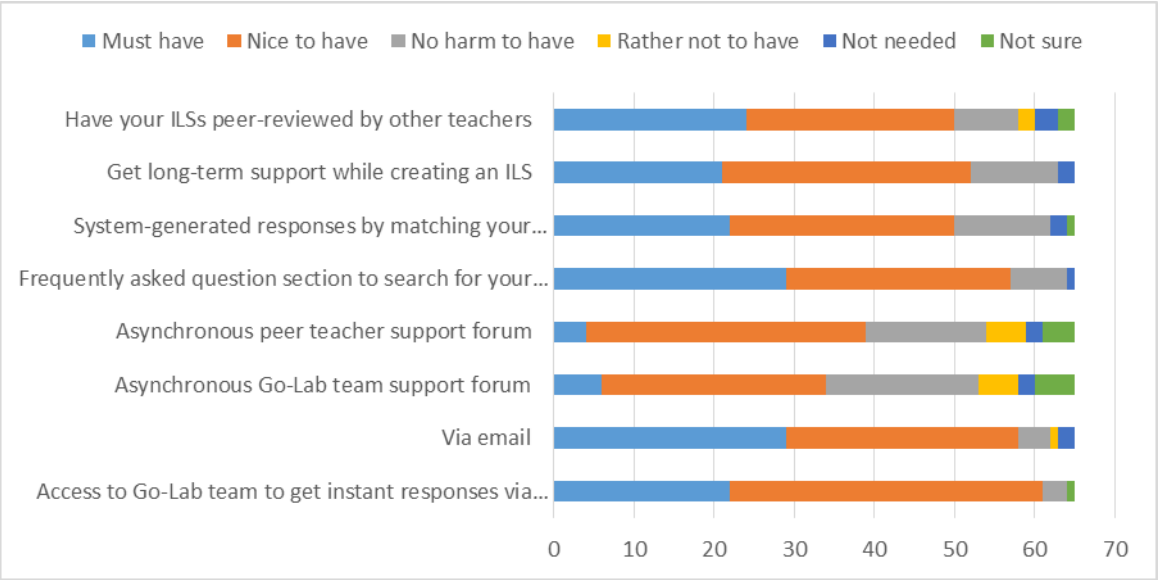


Figure 96. Necessity rating for different proposed new Help and Support Services in Next-Lab

The truncated options in Figure 96 are:

- System-generated responses by matching your question with existing support resources.
- Frequently asked question section to search for your problem.
- Access to Go-Lab team to get instant responses via chat.

About you

a) How would you describe yourself in terms of your experience of using Go-Lab artefacts and services?

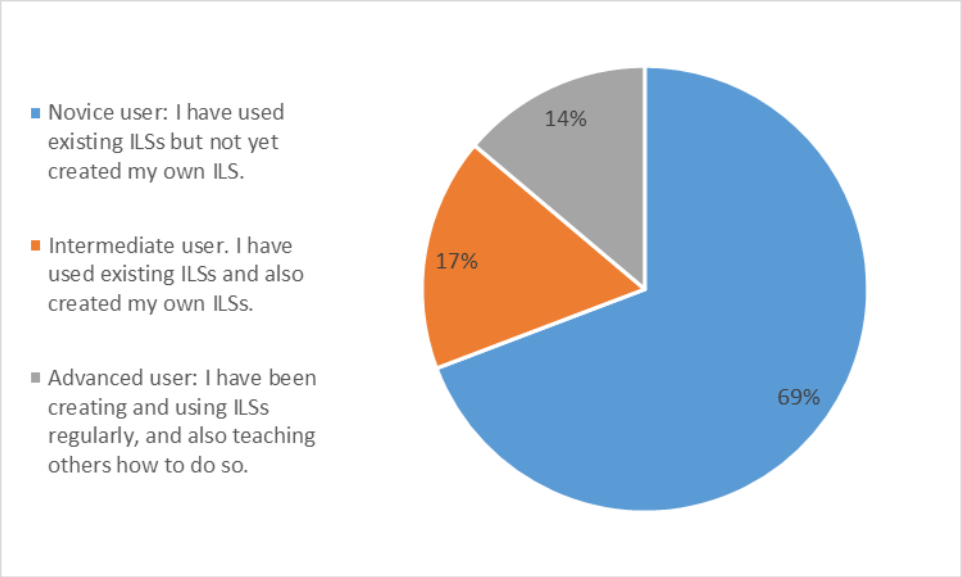


Figure 97. Participant responses regarding their experience with the Go-Lab system

b) Which type of academic institution are you teaching?

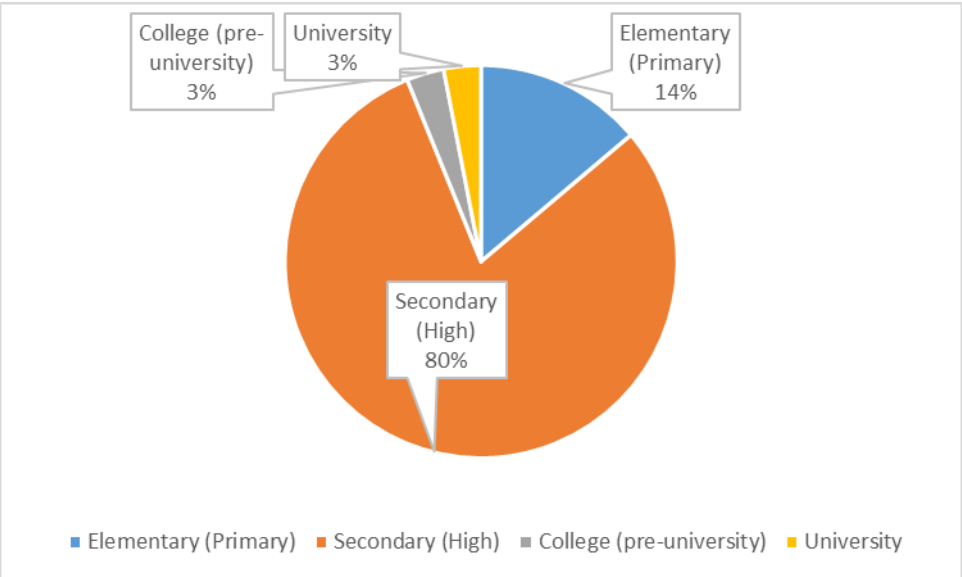


Figure 98. Participant responses regarding the academic institute they are teaching at

The overall assessment derived from these results is presented in Section 7.4.8.

ZZ. Example Response from a Developer

The short usability assessment of the new viewer application main conclusions were that the configuration was not enough created with the view of the teacher in mind. The configuration of the assessed viewer is shown in Figure 99.

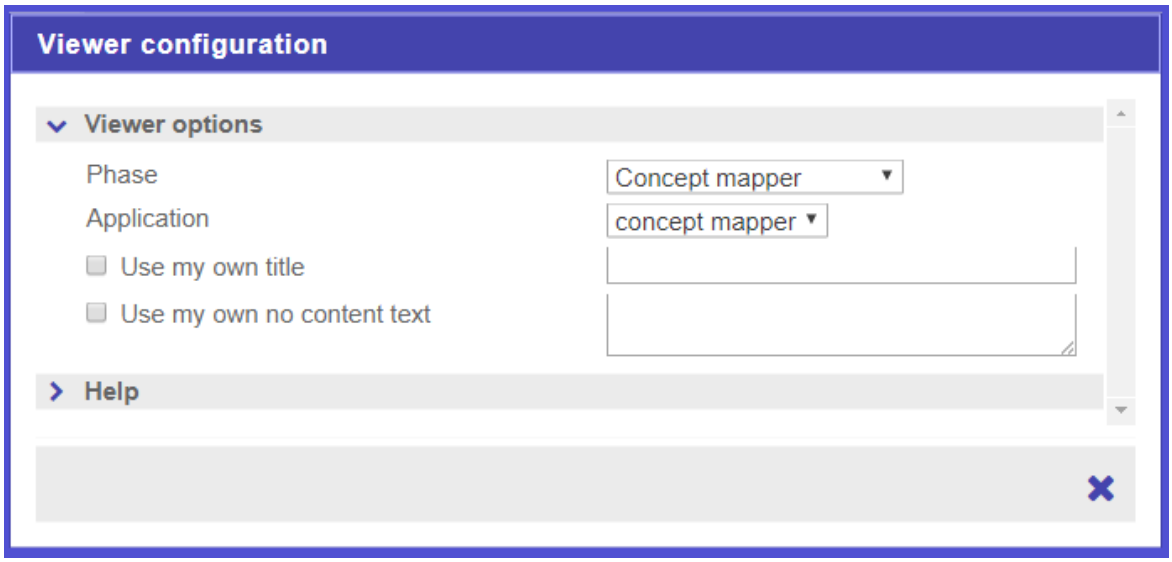


Figure 99. Evaluated Viewer configuration

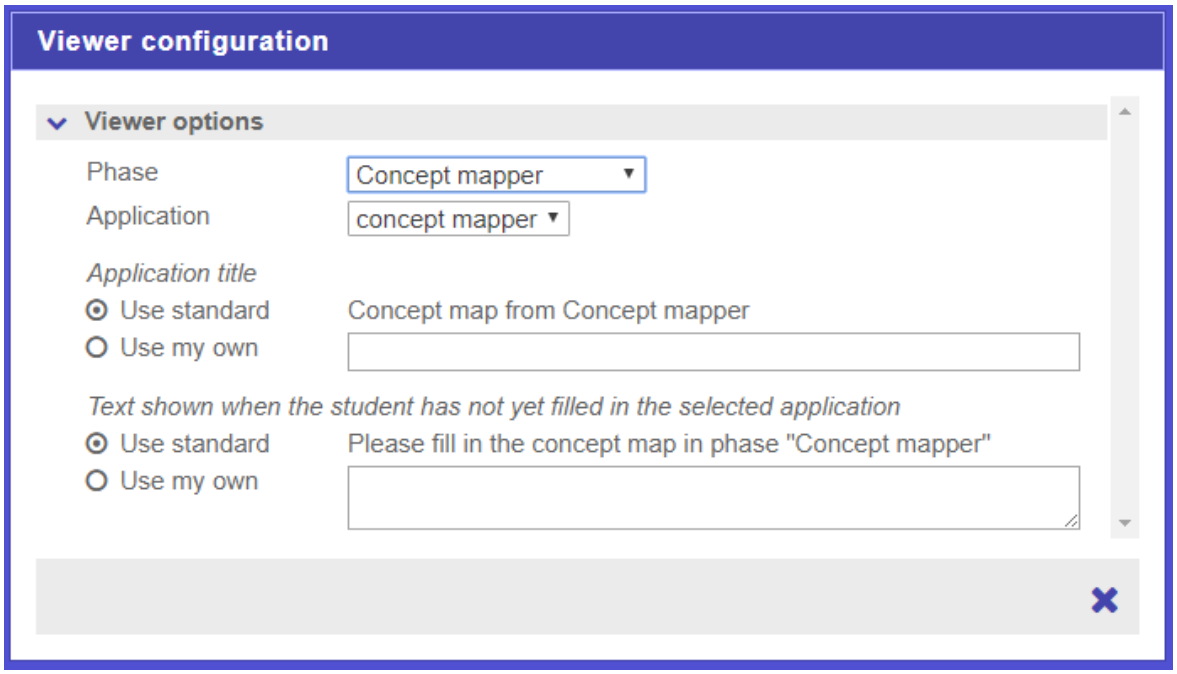


Figure 100. Reworked Viewer configuration

The configuration has been changed and is now showing the default text (as suggested). The text options are better explained. There is now also more screen space available for the teacher to enter their own title and text. As the viewer is a very simple tool for the students, the foreseen student help is not used. But the configuration of the student help was still present. The new configuration is shown in Figure 100.

The assessment found also a bug occurring when a lot of changes were made to the configuration of the viewer, which resulted in an internal error and the modified configuration was not saved. This bug has been fixed.

The general adoption of findings by developers, of which this response is an example, is described in Section 9.1.