# GO-LAB MOOC – AN ONLINE COURSE FOR TEACHER PROFESSIONAL DEVELOPMENT IN THE FIELD OF INQUIRY-BASED SCIENCE EDUCATION

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## Abstract

This paper represents a concept of a Massive Open Online Course (MOOC) targeting science teachers wanting to enrich their teaching practice with inquiry-based learning activities and the use of innovative online laboratories. This MOOC provides theoretical materials on the subject of inquiry learning, practice-oriented information on the use of online labs, as well as a technical framework for teachers to create virtual Inquiry Learning Spaces that can be used in the classroom. The course also offers the possibility for teachers to enter an online teacher community, where they can receive and provide support on the inquiry learning topics.

Keywords: Technology Enhanced Learning (TEL), Inquiry-Based Science Education (IBSE), Massive Open Online Course (MOOC), teacher professional development, inquiry learning, online laboratory.

## 1 INTRODUCTION

Nowadays, school education in Europe experiences significant changes in terms of used technologies and teaching methods. An increased use of modern devices like computers, tablets, and smartphones, as well as software programs and applications for learning addresses the needs of todays “digital natives” generation and becomes common place. Schools are equipped with computer classrooms, electronic devices, and high-speed internet connection. Supported with innovative technologies, teaching techniques become more practice-oriented, shifting the focus from theoretical presentation-based instruction to inquiry-based activities enabling students to gain hands-on experience with the topics of study. This is especially the case in teaching science. The Inquiry-Based Science Education (IBSE) approach becomes more and more widespread in school education aiming to improve science teaching, to motivate students for studying and doing science, and to assure that Europe has enough competent young scientists in the future [1]. In scope of the inquiry learning activities, students gain knowledge and experience by starting from research questions and solving scientific problems. This can be supported not only with the use of real laboratory equipment, but also with the use of desktop- and web-based software tools [2].

The European research project Go-Lab (Global Online Science Labs for Inquiry Learning at School, www.go-lab-project.eu) started in 2012 with the aim to develop a technical infrastructure supporting inquiry-based learning activities and to assist school teachers in implementing the IBSE approach with the use of online laboratories into their teaching practice. To reach this aim, firstly, the Go-Lab Portal (www.golabz.eu) has been developed enabling teachers to search for online laboratories and supporting web applications (inquiry learning scaffolds) and combine these in structured Inquiry Learning Spaces (ILSs) which can be customized by the teachers according to their lesson scenarios and shared with the students to be used in the classroom [3], [4], [5], [6], [7]. Secondly, teacher training is organized in fifteen European countries in order to support teachers in creating inquiry-based pedagogical scenarios and implement these in their classes using the Go-Lab Portal. Currently, more than 500 schools (800 teachers) participate in Go-Lab training and this number is planned to double during the project time. Finally, Go-Lab provides online support for teachers who are not able to attend presence training or want to extend their knowledge. On the one hand, this is realized by offering virtual tutoring sessions and webinars at the Go-Lab Tutoring Platform (http://tutoring.golabz.eu, [8]). On the other hand, a structured online course is provided.

This online course “Using online labs in the classroom: an introductory course for teachers” (further “Go-Lab MOOC”) is a Massive Open Online Course (MOOC) which can be attended by any interested person and can handle hundreds of participants. The course has been developed to support teacher professional development making it more flexible in terms of time and place. This is important as presence participation can require temporal and financial efforts that cannot always be covered by

schools or teachers themselves. The Go-Lab MOOC provides learning resources in form of video lectures and reading materials explaining the basics of the IBSE approach and gives instructions in form of detailed demo-videos on how to use the Go-Lab Portal and online laboratories. But more importantly, the course itself follows the inquiry-oriented approach allowing the participants to gain hands-on experience with the represented tools. It provides practical exercises to be conducted in the Go-Lab Portal where the course participants can, firstly, experience the use of online labs and inquiry learning applications as students and, secondly, try out the authoring environment for teachers to create own Inquiry Learning Spaces which can be later used together with the students in the classroom. Moreover, the course participants can receive support from the Go-Lab experts and collaborate with each other using the Go-Lab Tutoring Platform.

In this paper a concept of an inquiry-oriented Massive Open Online Course for teacher professional development is represented on the example of the Go-Lab MOOC "Using online labs in the classroom: an introductory course for teachers". As an introduction to the topic, the paper provides some basic information about the MOOCs as well as an overview of currently available MOOCs for teacher professional development and MOOCs including the use of online laboratories. After that, the paper presents motivation for the creation of a teacher training in MOOC format, defines the goals of the course, and sketches its structure. In the next section, particularities of the content development and technical implementation are described. The ways to support knowledge transfer into practice (with help of practical exercises and collaborative learning activities) are represented. Finally, future development and dissemination perspectives are outlined.

# 2 MASSIVE OPEN ONLINE COURSES (MOOCS)

## 2.1 What are Massive Open Online Courses?

The term Massive Open Online Course (MOOC) emerged in 2008 to describe a particular type of online course that allowed very large number of participants ("massive") and was freely accessible for anyone at no charge ("open") [9]. The first MOOC was developed by fellow Canadian academics Stephen Downes and George Siemens and was offered in 2008 to 25 students. In 2011, the MOOCs attracted wider public attention after the start of several courses developed by Stanford University in which hundred thousands of students enrolled. Shortly after this success, MOOC platforms like Coursera[1] and edX[2] were launched. In the last years, MOOCs evolved rapidly in terms of pedagogy and technical implementation [10]. Today, a large variety of products carries the MOOC label. The term is applied to any course which is offered online, without formal entry requirements, free of charge, and at a scale [11]. As a result of combining different pedagogical approaches, new kinds of MOOCs appeared: extended MOOC (xMOOC) based on presentation-based instruction approach and being similar to a university lecture, but extended with additional, collaborative activities, constructivist MOOC (cMOOC) based on collaborative learning approach and being similar to a colloquium or seminar, blended MOOC (bMOOC) representing a combination of classroom format and open course, and many others [9]. The MOOC proposed in this paper provides pre-defined instructional materials and has strong hands-on and social elements and, thus, belongs to the xMOOC category.

MOOCs are provided through platforms featuring functionalities and structure similar to a Learning Management System (LMS). Thus, the courses are broken down into modules containing various types of content, such as video lectures, text documents, and quizzes. The modules can be made all available for the participants at the course start or published weekly, one by one in the continuation of the course. For the course authors, the MOOC platforms provide functionalities for content and participant management, as well as course administration. A typical MOOC lasts over four to ten weeks, of which most are devoted to studying learning materials and a final week to preparation for a test or production of a piece of work. On average, students dedicate to a course two to six hours a week. Certificate of completion is issued if all required materials were studied and the final test was successfully completed by the participant. However, most of the courses aim at lifelong learners and do not offer certification. After the course is closed, the course materials remain accessible for the participants [11]. In this paper, we propose a concept of a MOOC provided through an LMS-based platform in combination with an inquiry learning portal in which practical exercises and participant collaboration take place.

[1] Coursera: www.coursera.org

[2] edX: www.edx.org

The leading MOOC platforms count thousands of courses created by renowned universities and training organizations and being offered for millions of students all over the world. For example, Coursera currently features 1,285 courses and edX – 513 courses. European MOOC platforms also demonstrate rapid development. As of May 2015, about 1,400 MOOCs are offered by European providers from 18 countries [12]. Such MOOC platforms as Miriada X (Spain)[3], iMOOC (Portugal)[4], FutureLearn (UK)[5], FUN (France)[6], as well as openHPI[7], OpenCourseWorld[8], and iversity[9] from Germany, play significant role for online education in Europe hosting not only university courses, but also MOOCs for vocational training [13].

## 2.2 MOOCs for teacher professional development

Whereas the first MOOCs targeted university students (and the number of these courses still prevails over the number of courses offered for other target groups), multiple MOOCs for vocational training and lifelong learning can be found at the MOOC-providing platforms. In addition to the professional development courses covering programming and soft skills training, a big number of MOOCs for school teachers is represented. If searching for teacher professional development courses in the web, for example on the MOOC List website[10], more than 130 courses can be found. These courses are provided at MOOC and online education platforms, such as Coursera, Canvas Network[11], FutureLearn, MOOC-Ed[12], European Schoolnet Academy[13], MiriadaX, NovoEd[14], UPVX[15], edX, Open Learning[16], and FUN. The courses are offered mostly in English and Spanish and cover various topics, such as teaching skills, soft skills, language teaching, science teaching, and the use of the Information and Communication Technology (ICT) in the classroom.

For this paper, the MOOCs focusing on science teaching are of particular interest. An example of such MOOCs is a teacher professional development program “Inquiry Science Learning: Perspectives and Practices” provided at Coursera and consisting of four MOOCs: “Science Leadership”[17], “Techniques for Success”[18], “Science Content”[19], and “Student-Centered Inquiry”[20]. The program is designed to help science educators in developing skills needed to create powerful science learning environment in the classroom and to move from a top-down content delivery model of instruction to the inquiry-oriented, student-centered model in which the teacher guides students helping them to create shared meaning of important science concepts. Compared to the MOOC described in this paper, these courses do not focus on inquiry learning tools and their use, but concentrate on teaching and soft skills needed by science teachers to be successful in their work. Such skill-oriented and technology-oriented MOOCs are mutually complementary and can be studied by the teachers in parallel.

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[3] Miriada X: www.miriadax.net

[4] iMOOC: http://eco.imooc.uab.pt/elgg

[5] FutureLearn: www.futurelearn.com

[6] FUN: www.france-universite-numerique-mooc.fr

[7] openHPI: https://open.hpi.de

[8] OpenCourseWorld: www.opencourseworld.de

[9] iversity: https://iversity.org

[10] MOOC List: https://www.mooc-list.com

[11] Canvas Network: www.canvas.net

[12] MOOC-Ed: http://www.mooc-ed.org

[13] Europen Schoolnet Academy: www.europeanschoolnetacademy.eu

[14] NovoEd: https://novoed.com/courses

[15] UPVX: www.upvx.es

[16] Open Learning: www.openlearning.com

[17] ”Science Leadership” MOOC: www.coursera.org/course/scileadership

[18] ”Techniques for Success” MOOC: www.coursera.org/course/inquirytechniques

[19] ”Science Content” MOOC: www.coursera.org/course/scicontentsurvey

[20] ”Student-centered Inquiry” MOOC: www.coursera.org/course/scistudentinquiry

An example of a teacher professional development MOOC, oriented on teaching tools for everyday practice, is the "Innovative Practices for Engaging STEM Teaching"[21] course offered by the European Schoolnet Academy. This course aims to provide teachers with ideas and resources (such as inquiry-based pedagogical scenarios, scientific data archives, online laboratories, virtual visits to scientific centers, and others) aiming to increase students' interest in STEM subjects. The resources represented in the MOOC are offered by renowned scientific organizations and projects and can be used by the course participants for their teaching activities during and after the course free of charge. In contrast to the Go-Lab MOOC, practical learning activities with those tools are not directly integrated into the course structure.

The last example of a professional development MOOC for science teachers is the MOOC "Assessment for Learning in STEM Teaching"[22] offered at FutureLearn platform and aiming at helping STEM teachers to apply effective assessment techniques in classroom and laboratory in order to find out what has been understood by the students and whether they need further explanations and assistance by the teacher. The represented assessment techniques are applicable not only for presence learning activities, but also for those taking place in a virtual learning environment, which is especially important for those teachers using online learning tools and online labs in their class. Such course can be studied in combination with a technology-oriented MOOC in order extend participants' understanding of learning analytics techniques and tools.

In this paper, a teacher professional development MOOC is represented, focusing on resources and tools for science teaching (partly overlapping with the tools covered in the MOOC of European Schoolnet Academy mentioned above) and their practical use in the classroom. The proposed MOOC provides not only theoretical information about the inquiry applications and online labs, but also gives the course participants hands-on experience of using them in an inquiry learning environment, which differentiates this MOOC from other teacher professional development courses described above.

## 2.3 MOOCs including the use of online labs

The idea of a MOOC, a course involving a large number of participants, makes it rather complicated to enrich such course with assignments, practical activities, or experiments. Because of this reason, most of the MOOCs deliver theoretical materials in form of video lectures and text documents that can be studied by the course participants at their own pace and without supervision of an instructor. Some courses offer assignments with peer-to-peer assessment and only few courses provide seminars and colloquiums in form of webinars. Teaching science and other subjects requiring conduction of hands-on activities becomes difficult due to the limitations of the online course format. The use of web-based tools, such as programming simulators for IT-related subjects and online laboratories for STEM subjects, represents a solution enabling the online course providers (universities and training organisations) to create courses covering both theoretical and practical parts of the training and providing complete learning experience for the course participants.

Despite obvious advantages for online learning offered by the online labs, their use in the MOOCs is not widespread as yet. There are some physics courses at Coursera (e.g., "Fundamentals of Electrical Engineering Laboratory"[23] and "Introductory Physics I with Laboratory"[24]) offering the use of remote and virtual physics laboratories to extend theoretical course materials with practical exercises. Further, a physics course using a remote lab VISIR[25] (Virtual Instrument Systems in Reality, a lab for testing electronic circuits) was designed by the University of Distance Education, Spain, and offered in 2013 to more than 2,000 students. Finally, the University of North Carolina at Chapel Hill, USA, launched the astronomy MOOC "Astronomy with Skynet: Our Place in Space!"[26] in which students can learn how to operate robotic telescopes and use them to observe different space objects.

This paper represents a concept of a MOOC for teachers wanting to incorporate the use of remote and virtual online laboratories in their everyday teaching practice. Similar to the courses described

[21] "Innovative Practices for Engaging STEM Teaching" MOOC: www.europeanschoolnetacademy.eu/web/innovative-practices-for-engaging-stem-teaching

[22] "Assessment for Learning in STEM Teaching" MOOC: www.futurelearn.com/courses/assessment-for-learning

[23] "Fundamentals of Electrical Engineering Laboratory" MOOC: www.coursera.org/course/eefunlab

[24] "Introductory Physics I with Laboratory" MOOC: www.coursera.org/course/phys1

[25] VISIR online lab: http://visir.ieec.uned.es

[26] "Astronomy with Skynet: Our Place in Space!" MOOC: http://skynet.unc.edu/introastro/ourplaceinspace/

above, this course offers access to remote and virtual science labs for the course participants. In contrast to other MOOCs devoted to STEM subjects, the proposed course does not target students studying particular science discipline, but it targets science teachers wanting to learn about inquiry-based education, innovative pedagogical scenarios, online labs, and inquiry learning applications. Another difference is that the online labs and tools represented in the course can be used by the participants also after the course finish. Finally, in this course, the online labs not only extend and visualise theoretical material, but also give participating teachers the opportunity to create templates that they can later use in real classroom activities together with their students.

# 3 THE CONCEPT OF THE GO-LAB MOOC

## 3.1 Motivation and aims of the course

The use of remote and virtual online laboratories as well as inquiry-based learning methods is quite new for the school education. In order to assure that inquiry learning activities are meaningfully incorporated into existing curriculum and pedagogical scenarios, it is important not only to provide appropriate technical framework containing online labs, but also to train the users (school teachers) in applying new teaching techniques and tools. As it is not always possible for teachers to participate in a presence professional development training, it is necessary to offer other opportunities for them to gain theoretical knowledge and hands-on experience independent of time and place. This can be done by means of an online course which can be used stand-alone or as an extension to a presence training, e.g., helping the participants to recall information or deepen their knowledge, and being accessible free of charge for any interested persons.

The MOOC "Using online labs in the classroom: an introductory course for teachers" has been developed in scope of the Go-Lab project with the aim to introduce school teachers to Inquiry-Based Science Education (IBSE) approach and train them in creating inquiry-based lesson scenarios as well as using online laboratories and inquiry learning applications (apps) for classroom activities. The format of a Massive Open Online Course (and respective technical implementation at an LMS-based MOOC platform) was selected in order *to provide the course to an unlimited number of participants* making the materials available for any teacher interested in inquiry learning. Furthermore, in order *to assure easy transfer of knowledge into practice*, each module of the course representing a pedagogic scenario is connected to the Go-Lab Portal (www.golabz.eu) where the teachers can find online labs and inquiry learning apps suitable for their class and combine them in customized Inquiry Learning Spaces (ILSs) that can be later used together with the students in real classroom activities. Finally, in order *to provide personal support to the participants*, the course is linked to the Go-Lab Tutoring Platform (http://tutoring.golabz.eu) where video sessions with experts can be arranged.

The learning goals of the Go-Lab MOOC can be defined as follows:

1) To introduce the course participants to the IBSE approach, explain pedagogic background and motivation for the use of online labs in school education;
2) To provide the course participants with detailed explanations of how to create inquiry-based lesson scenarios and meaningfully incorporate the use of online labs in classroom activities;
3) To give the course participants examples of inquiry learning scenarios supported with online labs and the possibility to try these acting in the student role;
4) To train the course participants in creating Inquiry Learning Spaces including selected online labs and customized according to own lesson scenarios;
5) To support the course participants in transferring gained knowledge and experience into their teaching practice.

The course does not require any prior knowledge in the field of inquiry learning or experience in using online labs. The course participants should have good English language and computer skills (e.g., experience in the use of internet and web-based applications) in order to be able to understand the course contents. Although the course is recommended for the school teachers, it can also be attended by any person interested in inquiry learning, for example, researchers, educational providers, online lab programmers, and lifelong learners.

## 3.2 Format and structure of the course

The Go-Lab MOOC is an online course with defined start and end dates, requiring registration which will be offered several times a year and can be completed by the participants without regular supervision of an instructor. If necessary, an online session with the course supervisor or any other expert can be arranged at the Tutoring Platform. The course has a planned duration of five weeks; however, the course participants can study at their own pace and complete the course in less or more time.

The course contains five learning modules. The first module “Inquiry learning with online labs” represents theoretical background of inquiry learning and the use of remote and virtual laboratories in school education. Here, several video lectures and additional reading materials are provided. This module does not contain any practical exercises; however, the access to the inquiry learning portal (Go-Lab Portal) is already given, so the participants can login and try out the system. The second module “Creating lesson scenarios and inquiry spaces” gives detailed explanations on how to create inquiry-based lesson scenarios and implement these in virtual Inquiry Learning Spaces structured according to phases of the inquiry learning process and containing online labs, inquiry learning apps, and other educational resources previously selected by the teacher. This module provides multiple videos demonstrating the use of templates and online tools offered in the Go-Lab Portal. There are several exercises helping the participants to understand basic interfaces and functionalities of the Portal and to find and try out different online labs.

The other three modules are practice-oriented, each focusing on a set of online labs and tools supporting particular lesson scenario (devoted to the solar system, galaxies and their interactions, and particles) and each planned to be studied in one week. These practice-oriented modules aim at providing teachers with ideas on how to create their own lesson scenarios including represented online labs and how to implement these in Inquiry Learning Spaces (ILSs). Besides video lectures and demo-videos, the modules offer exercises that can be carried out in the Go-Lab Portal and allow the course participants gaining hands-on experience with pre-defined ILSs and pre-selected online labs (using them as a student). As a next step, participants create own ILSs using the authoring environment for teachers, which interfaces and functionalities were previously represented in detail in the second module. This way the course participants train the use of the authoring environment while studying each course module implementing different lesson scenarios and selecting different online labs. With help of these exercises, the course participants can not only learn how to prepare inquiry-based activities, but also prepare real activities for their students to be later used in the classroom.

The course materials, online laboratories, as well as Inquiry Learning Spaces created by the participants remain available also after the course closure. Certificate of completion is available for download as a PDF-file after the course is completed by the participant.

# 4 THE DEVELOPMENT OF THE GO-LAB MOOC

## 4.1 Creation of instructional materials

The course materials basically include two types of learning content: video materials (video lectures, video excursions and demo-videos) and reading materials (scripts of the videos in form of text documents and PowerPoint-presentations, scientific articles, web resources, book recommendations, and so on). All of these instructional materials were created by renowned European research and educational institutions experienced in constructing inquiry-based learning activities, working with online laboratories, and providing professional development training for teachers. The course materials were created considering different levels of prior knowledge and language skills providing tips and additional explanations to the most critical topics. Furthermore, the course materials are designed to be used independently from any other learning resources, so the course participants can gain desired knowledge using the MOOC only. On the other hand, recommendations for additional resources are provided for those participants wanting to extend their learning activities beyond the course.

The video materials represented in the course can be of three kinds. The first kind – video lecture – provides theoretical information on the topic of a learning module. In the video lecture, an instructor gives explanations accompanied by PowerPoint-slides which are represented on the screen. In some cases, an animation or a screencast can be integrated into the video lecture. The second kind of video materials – video excursion – is similar to a video lecture showing the instructor and descripting key

definitions in text-boxes on the screen. The difference to a video lecture is that a video excursion has a less formal format providing supplementary information to the topic of study and often being recorded in a non-classroom setup (for example, science museum or telescope room). Also, a video excursion is not accompanied by PowerPoint-slides or scripts. To ease the understanding by the participants who are not English native speakers, subtitles or text-boxes with tips and explanations are provided. The third kind of materials – demo-video – represents a screencast accompanied by voice comments, text-boxes or subtitles and demonstrating the use of software tools for inquiry learning.

The reading materials offered in the course target several goals: (1) to ease the understanding of video materials by the participants; (2) to give the participants a possibility to read, learn or quickly repeat studied learning material; and (3) to provide additional learning resources extending the information represented in the course. Thus, scripts of the video lectures are provided in form of text documents or PowerPoint-slides available for download as PDF-files. Scientific articles are uploaded to the course environment or linked as web-resources. Moreover, book recommendations as well as links to external websites and resource databases are listed in order to simplify the search for literature and useful tools for the participants. Finally, document templates are offered that can be used for practical activities (see the next section) and implementation of new teaching methods in the classroom.

## 4.2 Exercises and knowledge transfer

The main goal of the Go-Lab MOOC is to enable school teachers to use online laboratories and inquiry learning applications in scope of classroom activities for their students. Thus, by the course completion, the participants should be able to:

- Create lesson scenarios corresponding to the curriculum and including inquiry-based learning activities using online labs;
- Find remote and virtual labs and inquiry learning apps suitable for particular lesson scenarios;
- Create Inquiry Learning Spaces (ILSs) structured according phases of the inquiry learning process and containing educational resources and tools described in the lesson scenarios;
- Share created ILSs with the students and conduct classes using these ILSs;
- Use Learning Analytics engine to analyze student's behavior and students' progress in the virtual learning environment.

As the first step, the course participants are trained in using Inquiry Learning Spaces and online labs as students in order to get the first impression of how the inquiry learning process looks like. After that, the participants learn to create inquiry-based lesson scenarios in a Word-template, describing the goals and planned learning outcomes of the lesson, the purposes of the lesson scenario, online and offline learning activities to be conducted during the class, as well as information, educational resources, and software tools that have to be provided to the students in each phase of the inquiry process. At the third step, the participants can search for online labs and inquiry learning apps appropriate for their lesson scenarios in the Go-Lab Portal. And finally, the course participants can create their ILSs either using pre-defined templates and customizing them, or from scratch. Importantly, during the whole process the course participants can work on the lessons scenarios and ILSs that they can later use in their teaching activities and provide for their students, which assures the transfer of gained knowledge into their teaching practice.

In order to provide personal support to the course participants and to facilitate participants' collaboration and experience exchange, each module of the MOOC is linked to the Go-Lab Tutoring Platform. Here, the course participants can join scheduled virtual tutoring sessions and webinars organized by the course supervisor and experts from the Go-Lab project consortium or directly contact the experts in case of questions. Moreover, successful course participants and other teachers experienced in the use of online labs can offer such tutoring sessions themselves and provide support to other members of the community. Finally, questions and comments to particular online labs, inquiry learning apps, and Inquiry Learning Spaces can be published by the participants directly in the Go-Lab Portal and will be answered by the experts in the user forum. Together with other community members, the course participants can reflect on their experiences and collaboratively find solutions for questions that might arise. This approach brings the Go-Lab MOOC beyond the concept of classical online course enriching it with collaborative learning activities and personal support.

## 4.3 Technical implementation

The Go-Lab MOOC “Using online labs in the classroom: an introductory course for teachers” is implemented at three platforms: the OpenCourseWorld platform (www.opencourseworld.de), the Go-Lab Portal (www.golabz.eu), and the Go-Lab Tutoring Platform (http://tutoring.golabz.eu).

The OpenCourseWorld platform is the main entrance to the MOOC, where the teachers can register for the course, study the course materials, and obtain the certificates after the course is completed. Here, the learning modules containing video and reading materials as well as the links to additional learning resources are presented. Figure 1 demonstrates how such course module looks like. On the left side of the screen, a menu listing the course materials (each type of material denoted with an icon) is represented. On the right side, selected learning resource is displayed. The tick box in the right upper corner of the screen allows the course participant to mark the resource as “studied”.

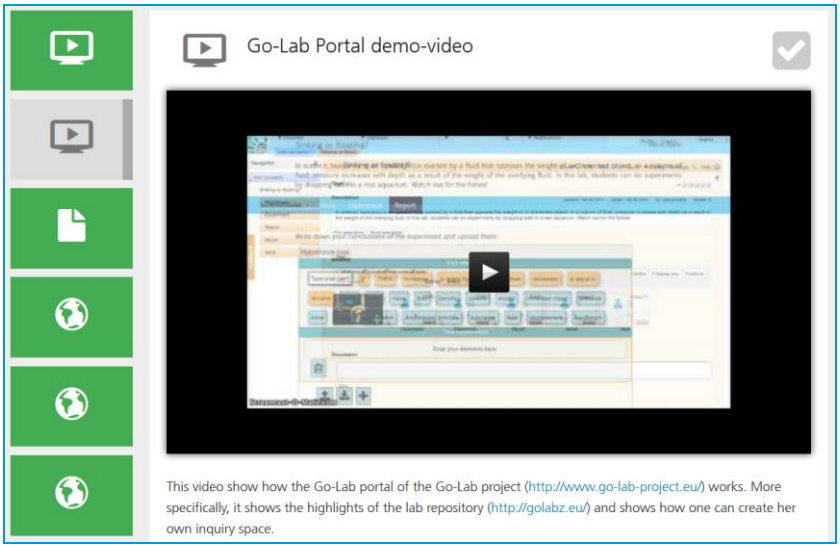


Fig. 1: Course module at the OpenCourseWorld platform

Practical exercises to be completed by the participants are also defined within the course modules at the OpenCourseWorld platform. Here, each task definition is provided with a link leading the learners to the Go-Lab Portal, where the task can be accomplished. In the Go-Lab Portal, online labs and inquiry learning apps can be searched and used, and Inquiry Learning Spaces can be created using the authoring environment. All tools represented in the Portal as well as the ILSs created by the participants can be used not only in scope of the course, but also in real education settings together with the students. Figure 2 represents an example Inquiry Learning Space created by a teacher using the Go-Lab Portal and a chemistry online lab “Methyl Orange”.

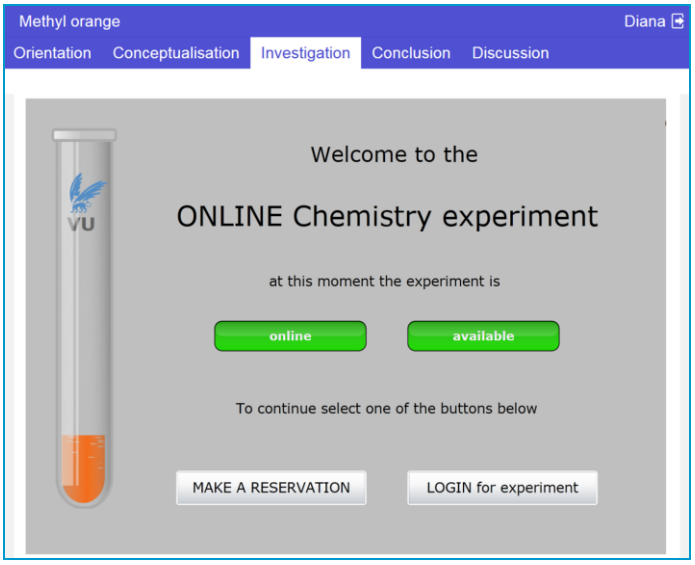


Fig. 2: Inquiry Learning Space

Finally, each course at the OpenCourseWorld platform is provided with a link leading the course participants to the Go-Lab Tutoring Platform where virtual tutoring sessions and collaborative learning activities take place. The Tutoring Platform is available not only for the MOOC participants, but for any teachers and users interested in inquiry learning and online labs. In this community, the Go-Lab MOOC participants can establish contact to the experts, teachers, and other community members and keep collaborating with them sharing experiences, as well as providing and receiving support also after the course completion. Thus, the MOOC participants become a part of a Europe-wide teacher community being able to use the inquiry learning infrastructure and interact with other stakeholders.

## 5 CONCLUSION

The use of online laboratories in MOOCs has a huge potential, as these can help the course participants (students, teachers, vocational learners, lifelong learners, and others) to better understand the theory and gain practical experience with a studied subject and its application in real-life settings. The online labs are relevant not only for online courses focusing on STEM subjects, but also for courses training the educators who will incorporate inquiry-based learning activities and corresponding software tools in their teaching practice. Providing an inquiry learning infrastructure enabling the course participants to construct their own virtual Inquiry Learning Spaces and to collaborate with other course participants and experts supports the transfer of knowledge into the practice and assures proper implementation of methods taught in the online course.

The teacher professional development MOOC “Using online labs in the classroom: an introductory course for teachers” (Go-Lab MOOC) described in this paper will be provided at a LMS-based MOOC platform connected to an inquiry learning portal and a community platform. This allows the course participants (science teachers) not only to study video and reading materials, but also to gain hands-on experience with remote and virtual labs, create own lesson scenarios and Inquiry Learning Spaces, use these ILSs in the class together with the students, and share and discuss own experiences in a teacher community. This MOOC aims at promoting and mainstreaming the implementation of inquiry-based learning methods in school education and at supporting science teachers in applying these methods and software applications, such as online labs and inquiry learning apps, in the classroom activities. All software applications provided in the course as well as ILSs created by the participants remain available after the course completion and can be used by the teachers.

The Go-Lab MOOC will be available for the school teachers all over Europe starting in summer 2015 and is expected to enroll hundreds of participants being promoted through various online channels, such as teacher communities and social media groups. The course will be available free of charge for any interested teacher. After the first run of the course, its structure and materials will be revised and adopted according to the participants’ feedback. Also, the learning materials will be updated in the course of the Go-Lab project in order to represent the latest developments in the field of inquiry learning with online laboratories. Possible improvements of the course provision form (e.g., hosting of the course at an open platform where the content can be accessed without registration or providing the course as a structured virtual learning space located directly in the inquiry learning environment) will be considered in order to make the course sustainable in a long-term perspective.

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## ACKNOWLEDGEMENTS

The authors thank the Go-Lab project and its consortium members who actively contributed to the creation of the Go-Lab MOOC: University of Twente, the Netherlands, Ellinogermaniki Agogi, Greece, École Polytechnique Fédérale de Lausanne, Switzerland, The Institute of Accelerating Systems and Applications, Greece, and Núcleo Interactivo de Astronomia, Portugal. We also thank Prof. João Fernandes and Dr. Telma Esperança from Geophysical and Astronomical Observatory of the University of Coimbra, Portugal, who contributed to the course creation as invited speakers.

This work is partially funded by the European Union in the context of the Go-Lab project (Grant Agreement no. 317601) under the Information and Communication Technologies (ICT) theme of the 7th Framework Programme for R&D (FP7).

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