Deploying EChemTest® Self Evaluation Sessions on the EOL Platform

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The ECHEMTEST⁺ Project

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1. The ECTN EChemTest® activities and structures

The European Chemistry Thematic Network (ECTN) Association has worked out in the past twenty years a core-chemistry European Syllabus following the guidelines published in ref. [1]. On this ground a set of several thousands Questions and Answers (Q&A) named EChemTest® (articulated into several libraries of different level of chemistry knowledge) has been created through the activity of various library committees. Since then, EChemTest® has become the reference e-learning product of ECTN and its Q&A libraries are regularly used for Academic purposes (guidance of students' curricula, evaluation of students' preparation, assignment of ECTS credits, etc.) by a large number of the ECTN member Higher Education Institutions (HEI)s to the end of carrying out Self Evaluation Sessions (SES)s for school, EuroBachelor® and Euromaster® students.

The EChemTest® activities are run by the ECTN Virtual Education Community (VEC) Standing Committee (SC). The VEC SC takes care (either directly or via third parties) of:
- managing the EChemTest® central platform and related e-testing software,
- maintaining and extending the English version of the Q&A Libraries,
- coordinating the National Test Centres (NTC)s,
- developing the evaluation metrics,
- producing related general statistics,
- carrying out centralized advertising and communication of the EChemTest® activities.

The NTCs support EChemTest® activities at national level by handling (either directly or through third parties) the:
- accreditation of the ATSs (Accredited Test Site)s,
- translation from English into national language and maintenance of the Q&A libraries,
- management of the network of national ATSs,
- harmonization of EChemTest® metrics with the national ones,
- national advertisement and communication.

The ATSs handle (either directly or through third parties) the
- secure delivering of SESs,
- production of related reports,
- carrying out of local advertisement and communication.

In order to be accredited as ATS ECTN member HEIs need to take part to a specific training event organized by the VEC SC. At present there are 13 ATSs most of which are also NTCs.

2. The ECHEMTEST⁺ project

As deliberated in Ljubljana (April 2015), a few months before the end of the second EC2E2N European project, ECTN undertook the reorganization of the EChemTest® activities (aimed at achieving financial sustainability also in the absence of Thematic Network funding) through the ad hoc project **ECHEMTEST⁺**. The first action undertaken by ECHEMTEST⁺ was the analysis of the costs met for running the EChemTest® SESs using the Perception software of Question Mark (QM) and of the features limiting its sustainability. As turned out from the VEC SC analysis, EChemTest® is the main ECTN asset (conservatively estimated to be worth about 2 M€). Within the EC_2E_2N projects its operational costs, estimated to be about 170 k€ per year, were met in real terms (using either direct or indirect money) to an extent of about 25% while the remaining 75% was provided in terms of voluntary work by VEC SC members as well as by the NTC and ATS personnel.

On that ground, it was decided to make EChemTest® sustainable by
a) starting the activity of issuing paid Proficiency Certificates on Chemistry, Chemical Engineering and Molecular Sciences competences for private individuals and/or company employees

b) adopt for the Academic utilization of the EChemTest® SESs run by HEI members of the association bearing one or more of the following activities:
- use EChemTest® for teaching and assessing,
- contribute to the development and translation of the Q&A libraries,
- act as NTC and/or ATS after signing the related MoU,
- contribute to the development of support material and related software tools.

2. Business Plan

More specifically, the business plan worked out for the ECHEMTEST⁺ project adopts the following guidelines:
-drastically reduce costs,
-activate sources of possible incomes.
Actions undertaken by ECTN to reduce costs consisted in the discontinuation of the QM licence and the temporary reduction of some VEC activities (f2f meetings, libraries maintenance, avertisement, etc.) while those undertaken to activate possible incomes consisted in promoting paid services through the Agencies. The main action undertaken to reduce costs was the adoption of an Open source software (EOL, Exams on line) in place of the previously adopted PERCEPTION. The main action undertaken to promote services was the implementation of a prosumer (producer – consumer) model. According to the Business Plan approved in April at the Malta AC (Administrative Council) and General Assembly (GA), this is expected to lead to a break even between incomes and expenditures by the year 2021 (with the consequent consolidation of the EChemTest® activities). The success of this step will provide a solid ground for the revision of the Q&A libraries, their finalization to more professional usage, the implementation of additional Q&A libraries, the implementation of more agile training procedures for the Test Centers operators, the utilization and development of a distributed repository of learning objects. This is, indeed, the final goal of the ECHEMTEST⁺ project and will enable the adoption of EchemTest® as a European standard for the evaluation of Chemistry knowledge.

3. LibreEOL

As already mentioned, the adopted e-test software is LibreEOL (Libre Exams On Line): an Open Source software designed and developed at the University of Perugia, Italy (see http://echemtest.libreeol.org/). LibreEOL is of free usage (no fees have to be paid and no limits are set for the number of users and SESs) and is compatible with the popular Moodle educational software. All in all, the yearly running costs of LibreEOL on the cloud are definitely smaller than the fees of QM while its Open Source nature is not subject to usage constraints.

References

1] A. Laganà, S. Crocchianti, N. Faginas Lago, A. Riganelli, C. Manuali, S. Schanze, From Computer Assisted to Grid Empowered Teaching and Learning Activities in Higher Chemistry Education in Innovative Methods in Teaching and Learning Chemistry in Higher Education, I. Eilks and B. Byers Eds, RSC Publishing (2009) p. 153-190 ; ISBN 978-1-84755-958-6

The EChemTest$^{@}$ libreEOL e-Assessment platform

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1. Introduction

As planned in the roadmap approved at the ECTN General Assembly held in Gdansk (April 2016), the migration of the English master version of the EChemTest$^{@}$ libraries on the Open Source platform LibreEOL [1] was completed by the beginning of September 2016 and the first training event was carried out immediately afterwards. During the migration a first revision of the Q&A Libraries was also performed by dropping about 30 questions (either because affected by text errors or because referring to types of questions non supported by LibreEOL).

Official SES runs based on LibreEOL EChemTest$^{@}$ Q&A Libraries begun on the next November 1st. During the time intercurring between November 1st and the Malta General Assembly (April 2017) several NTCs did run LibreEOL EChemTest$^{@}$ SESs and spotted further corrections to the Libraries.

The present version of the ECHEMTEST^{+} Training Booklet (presented in a draft form at the mentioned Malta General Assembly) is designed to drive Test Center managers to define, manage and deploy EchemTest SESs by illustrating the main features of *LibreEOL.* This software was produced at the end of the 90's within the Leonardo European project "*DASP - Distance Assessment System for accreditation of competences and skills acquired trough in company Placements"*[2] (http://cordis.europa.eu/project/rcn/49917_it.html) devoted to the promotion of Lifelong Learning.

The *LibreEOL* software was then further adapted to academic environments (to the end of enabling the handling of exams and tests related to university courses). Further extensions were introduced to the end of adapting the system also to commercial environments. It is a web application based entirely on Open Source/ Freesoftware components released under the GNU GPL license and embodies a complete environment designed for performing the e-assessment of a large number of students accessing the system from computer laboratories under the control and the supervision of an examiner. Each student is assigned an individual test made of a set of randomly selected questions belonging to a given subject and classified according to 3 levels of difficulty (low, medium, high). If needed, the teacher may force some questions to appear on all tests. The answers associated with each question are presented to the student in a randomized sequence.

Once registered to the LibreEOL web site, the student may enrol in the desired SES and, once received the password associated with it, she/he can run the SES. Questions are given in a list. The student may deal with related answers in the order she/he likes before considering the test completed and sending the responses to the LibreEOL server. The completed tests are reviewed by the examiner and related evaluations published. The session is then archived for future reference and statistical treatments from which useful information on the use and validity of the EChemTest$^{@}$ Libraries and on the response to their use by the students can be worked out for the different subjects in the different countries.

LibreEOL is available from a cloud provider (Amazon EC2) currently deployed on an Ubuntu 16.04 LTS, Apache 2 Web server and MariaDB MySQL server. Since the web application is designed on **Ajax** calls, the web browser has to fully support Ajax. Furthermore the web browser has to support **HTML5** and **Javascript**.

2. LibreEOL main features

LibreEOL enables administrators, teachers and students to carry out the operations described below.
As per the Administrator:
1.   Manage the information related to the web site (name, context, layout, etc)
2.   Create accounts for teachers, examiners and students
3.   Assign the Administrator privilege to teachers, if necessary
4.   Define the classrooms suitable for carrying out SESs

As per the Teacher:
1.   Create subjects subdivided in topics and manage only those under its jurisdiction
2.   Create questions of different types (Multiple Choice, Multiple Response, Yes/No, True/False, Assay question, Numeric, Text Match, Hot Spot, Pull own list, Filling the blanks) and difficulties (low, medium, high) and managing as well the students' responses.

As per the Examiner:

1. Set SESs with variable settings (number of questions, difficulty, etc)
2. Manage SESs in authorized classrooms using public or private subscription lists.
3. Produce the report of each SES and other types of report related to the statistical information about exams and students

As per the Student:
1. Register to the system with unique credentials
2. Enrol in a SES
3. Execute the test from one of the authorized computer rooms.

LibreEOL is multilingual. There are two separate aspects to be taken into account when considering the various languages available: the language of the User Interface and of the web pages (managed by the developers) and the language in which Q&As are formulated (managed by the teachers). Either the System Administrators or the developers have to specify the language localization by adding a subdirectory in the source files (under the langs directory) and adding two classes, one for the PHP related strings of text, the other for the Javascript ones. Each language is identified by the corresponding flag (shown in the web pages) so as to allow the student to change the language dynamically.

The localization of the questions and answers is, instead, under the Teacher control, who is responsible for adding the corresponding text in the considered local language for both questions and answers.

LibreEOL manages the localized libraries as an unique body with respect to the reference libraries. This fact allows the student to perform the same EchemTest$^@$ test by selecting the preferred language (this means that a student may run the SES in the language she/he prefers while the others may use other languages within the same SES).

References

1] Gervasi O., Laganà A. (2004) EoL: A Web-Based Distance Assessment System. In: Laganá A., Gavrilova M.L., Kumar V., Mun Y., Tan C.J.K., Gervasi O. (eds) Computational Science and Its Applications – ICCSA 2004. ICCSA 2004. Lecture Notes in Computer Science, vol 3044. Springer, Berlin, Heidelberg 854-862.
2] Project ID: 9700831, ET-LEONARDO DA VINCI 1 Coordinated by TUCEP - TIBER UMBRIA COMETT EDUCATION PROGRAMME, Perugia, Italy.

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LibreEOL Examiner Guide

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1. Logging in

In Figure 1 the access *LibreEOL login panel* obtained when typing http://echemtest.libreeol.org is shown. One can enter there either her/his credentials (*e-mail* and *Password*) if already registered into the system or click on the *Join* button in order to register for the first time into LibreEOL and provide the needed information as prompted by the *Registration panel* shown in Figure 2. In that panel is also possible to redefine the password through the email address associated with the login ID using the "*Password Lost?*" button.

The role considered by default by LibreEOL is "*Student*". If higher privileges are needed they have to be negotiated with the administrator using the email admin@echemtest.libreeol.org.

Figure 1: LibreEOL login panel
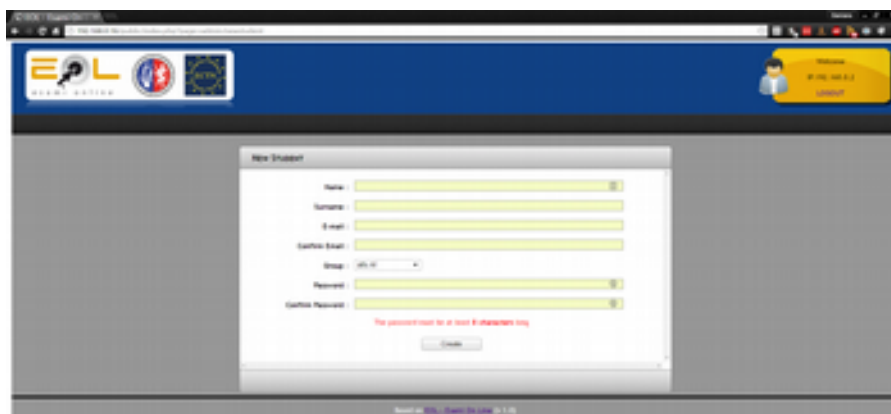
Figure 2: Panel for registering and setting the password

Figure 2 shows the *Registration and set password panel*.

2. Defining a SES

The main activity of a Test Centre is the management of the SESs. The first activity (to be carried out the first time the Test Centre manager accesses the platform and when the Teacher wants to change some operational parameters) is concerned with the definition of the *room* (the laboratory used for carrying out a SES, see the *Room Panel* of Figure 3) and of the settings of the SESs (see the *Setting Panel* of Figure 5).

The *Room Panel* shown in Figure 3 allows the Administrator to define the IP range of the Laboratory used for carrying out the tests. For security reasons, LibreEOL will enable connections to the server, aimed at carrying on exams, only from hosts bearing a specific range of IP addresses. The *Room* is associated with a given SES when the Examiner (or the Teacher) defines the exam. To the end of defining a new *Room*, a Teacher bearing the Administrator role has to access as such the system and specify the new *Room* to be made available for the next exams. The *panel for resetting the password* is shown in Figure 4.

Figure 3: Panel for defining the SES room

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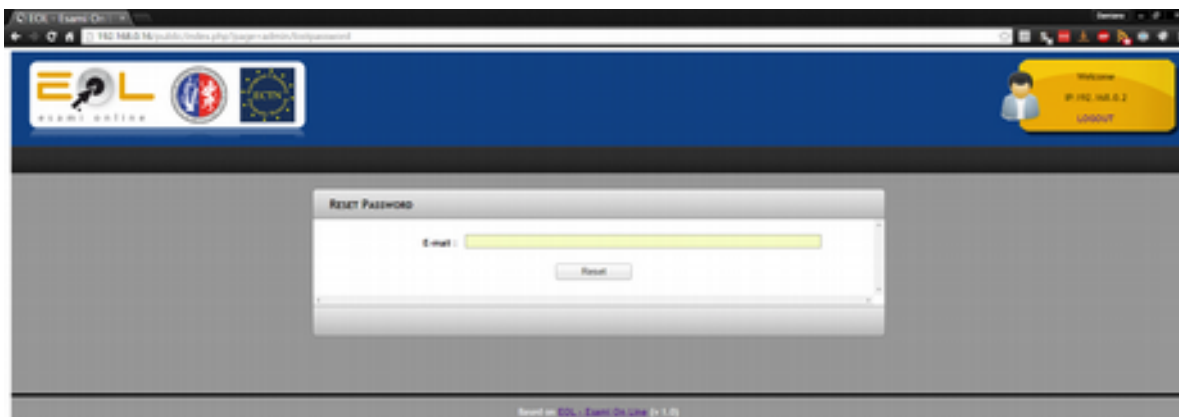
Figure 4: Panel for resetting the password

The *Setting panel* of Figure 5 allows to set the type of exam that the examiner wants to deploy (in University courses for example, there might be some pre-exams running on part of the topics, intended for students attending regularly classes, compared with the full exam, to be run on regular exam sessions). The top part of the panel is divided in three sections: the *General Information* (lhs), the *Questions per Topic* (center) and the *Questions per Difficulty* (rhs). In the lowest part of the panel the list of questions available per discipline is given in order to allow the Teacher to select the questions to appear in the test.
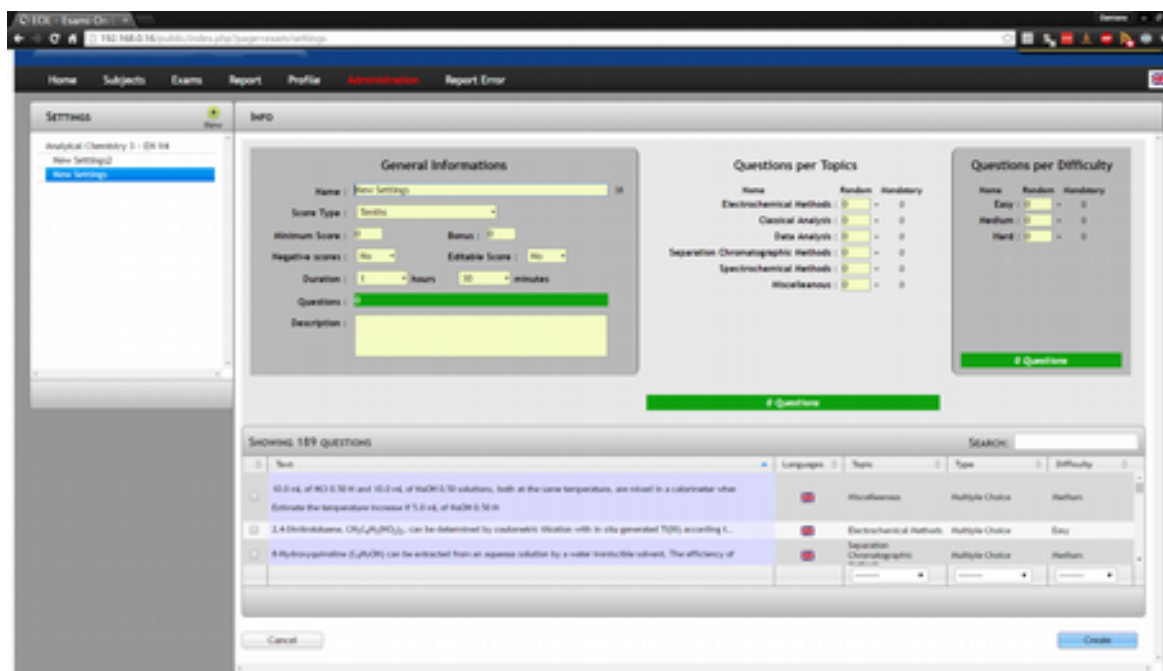
Figure 5: Setting Panel
Figure 5: Panel for defining the setting

The meaning of the various fields of the *General Information* section is the following;
Name: the name of the Setting
Score Type: type of scale used to express the score (tenths, thirtieths, hundredths)
Minimum Score: minimum value of the score allowing to pass the test
Bonus: amount added to the score of each test
Negative Scores (Y/N): if set to *No*, any negative score is set to 0
Editable Score (Y/N): the Examiner may adjust the final score manually
Duration: duration of each exam in hours and minutes

Questions: total number of questions selected from Topics, including common questions (i.e. questions selected from the lower panel to be included in each test)
Description: optional description of the present setting

The list of Topics from which the Teacher can select the number of questions per Topic and the number of questions per difficulty level the Teacher wants to select are shown in the central and the rhs section, respectively. The bar is green when the total number of questions of the central section is equal to the total number of questions of the rhs section while it is red otherwise.

Once defined the proper *Room* and *Setting*, the specific characteristics of the exam are defined in the *Exams panel* (see Figure 6) in which the list of defined exam sessions is shown. To add a new exam the teacher has to press the *New* button that makes the panel shown in Figure 6 to appear. The panel is divided in three sections: the lhs one is related to General Information, the central section is related to the details of the student registration, the rhs section is related to the selection of the Room. The meaning of the fields of the General Information section is the following:
Name: name of the exam
Subject: type of EchemTest library
Settings: type of setting selected
Day and Time: day and time of the exam
Description: description of the exam (if needed).

Figure 6: Panel for setting the specific characteristics of the SES

Students may register either manually or automatically. In the latter case, each student who connects within the time boundaries defined by the fields **Start** and **End**, will be able to register to the exam by entering the ad hocc password provided by the Examiner and carry out the test. In the right panel the Examiner can select the proper *Room* (the laboratory in which the test will be run). The exam SES is created by pressing the *Create* button and the resulting panel is shown in Figure 7 with the defined exam appearing on the top of the list. The password column shows the password associated with the exam and which has to be entered by the student to carry on the exam. The Examiner can perform some administrative tasks by pressing the icons of the *Manage* column: the pencil to edit the exam's properties (see Figure 8), the two puppets (orange and blue) to visualize the students carrying (or having carried) out the exam with related scores (see Figure 9), the power button to activate/deactivate the exam, the archive icon to archive the exam and finally the bin to delete the exam.

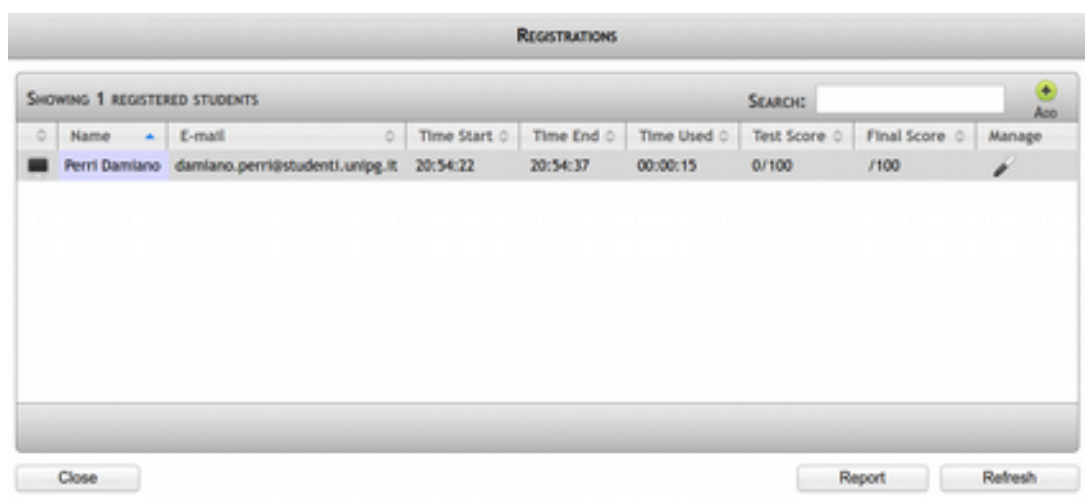*Figure 7: Panel for re-editing the SES properties*

Figure 8: Panel listing the students carrying out the SES

Clicking on the pencil shown in the rhs of the rows of the student's info (see Figure 10), the Examiner can check her/his answers. In the figure the right answers are marked in green and the related scores are shown (wrong answers are marked in red and no responses are marked in blue).
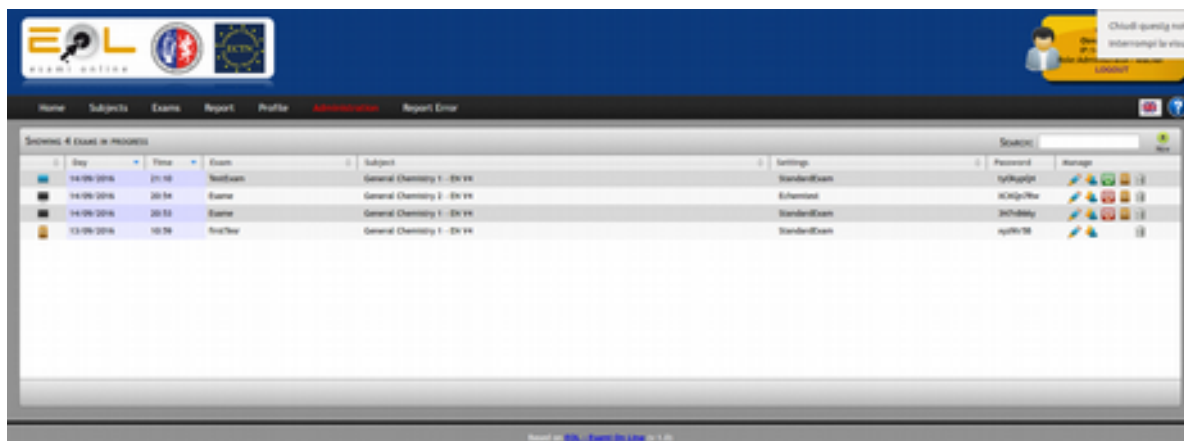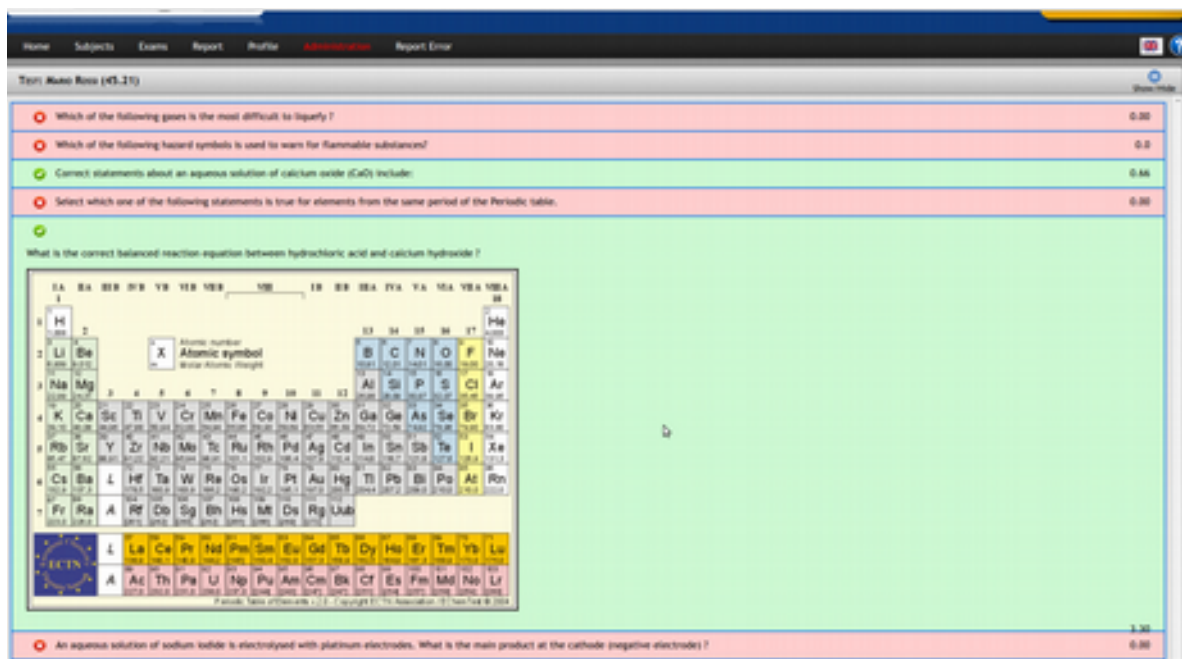

Figure 9: Panel listing the active SESs

Figure 10: Panel listing the questions asked and the answers given

3. Student's Guide

Once registered on the LibreEOL system, the student can carry on the exam by connecting to the URL http://echemtest.libreeol.org. The session can be started from the panel of Figure 11.
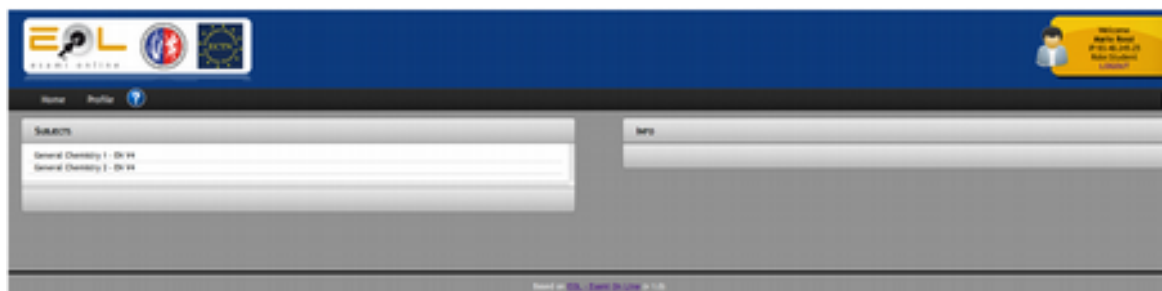
~~Figure 9: Panel the student will see once logged in~~
Figure 11: Panel shown to the student at logging in

On the left section of the panel the exams to which the student can register are shown. By clicking on one of the rows of the panel, the registration panel of the corresponding SES shows up (see Figure 12). By clicking on the pencil of the panel of Figure 12, she/he will register to the exam. The student will receive a request for confirming the registration to the exam (see Figure 13). Figure 14 shows to the user the SES starting panel by pressing the green arrow. If the IP address of the client does not match the one specified in the selected setting, the error message of Figure 15 will show up followed again by the confirmation and SES starting panels of Figures 16 and 17 respectively.
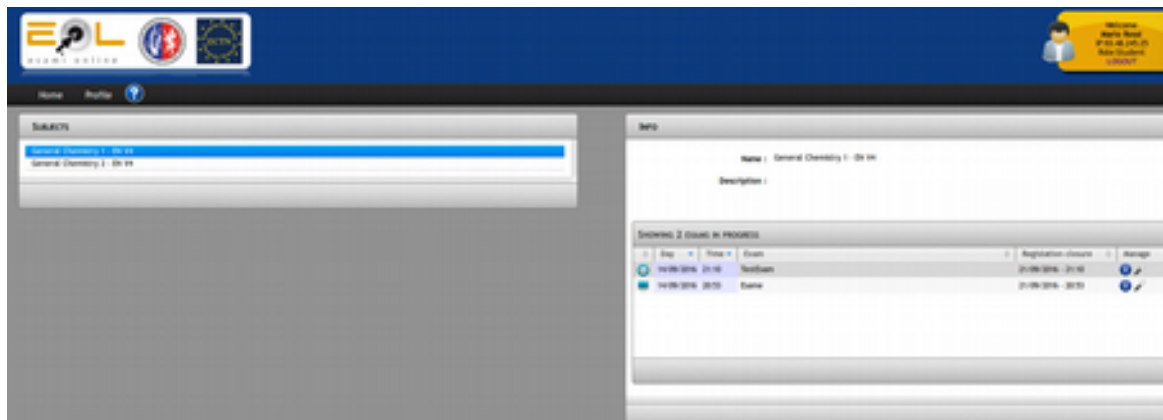
Figure 12: Student's registration panel to the SES
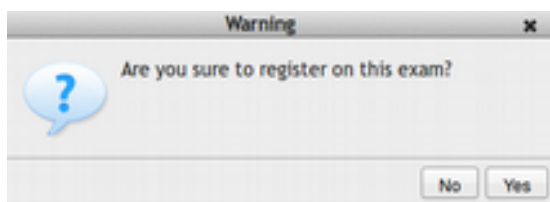
Figure 1311: Confirmation panel for exam
registration
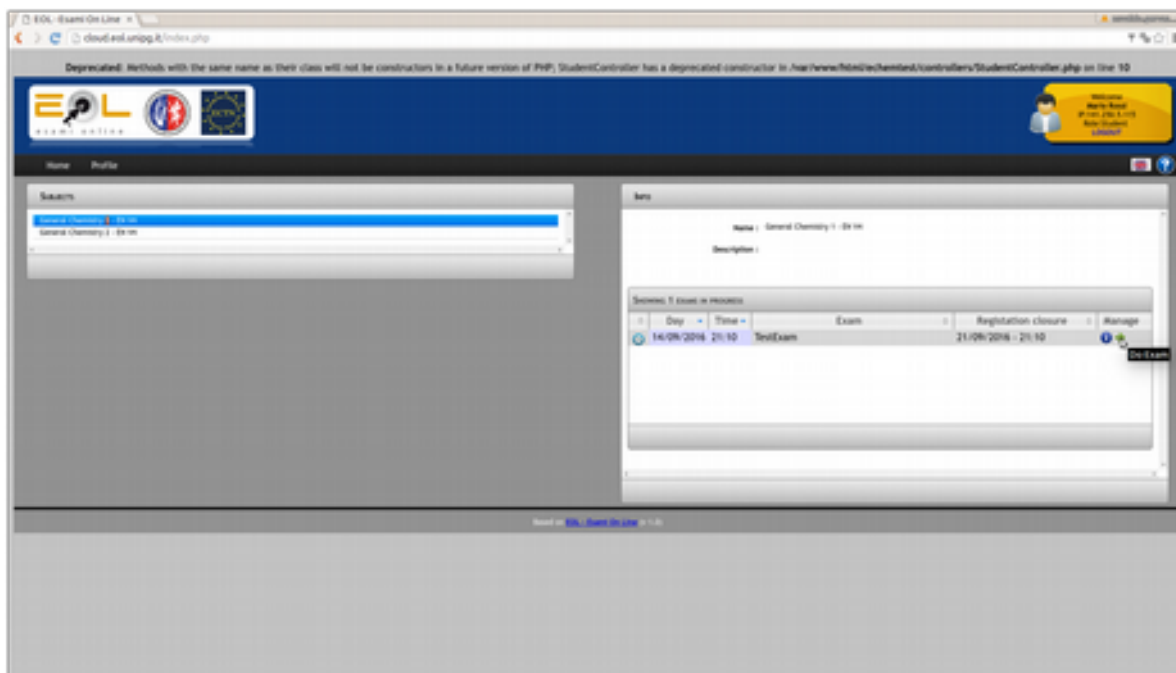
Figure 14: Student's session starting panel after registration

Figure 15: Information panel received if the IP of the client is not allowed to connect
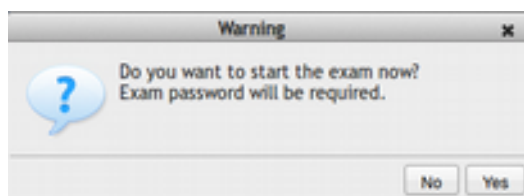
Figure 126: Information panel about the test starting

Once pressed the green arrow, a confirmation panel appears, as shown in Figure 16. In Figure 17 the panel related to the request of the password associated to the current exam is shown. This password should have been notified by the Examiner before starting the exam session.
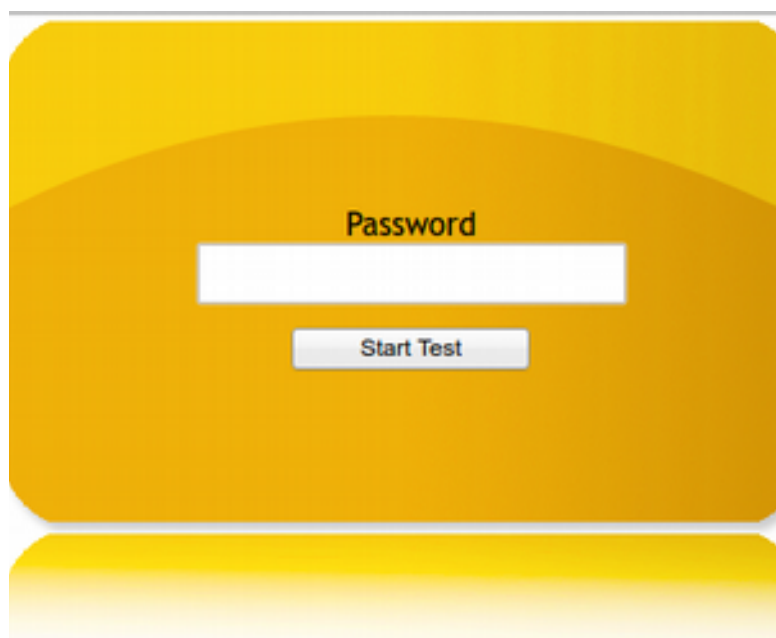
Figure 137: Panel related to the entering of the password to be provided in order to access the test

If the password is correct, the student will receive a warning as shown in Figure 18. When the student presses the OK button, the test will start.

Figure 19 shows the window that will appear after the test has started. A digital clock will remind the remaining available time for completing the exam.
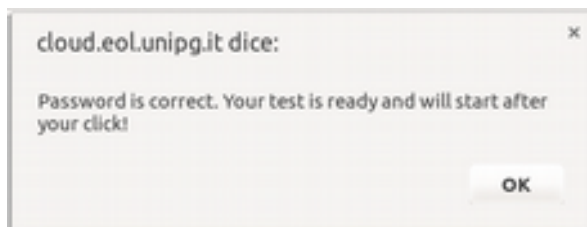
Figure 148: Panel informing that the password is correct and the test will start as soon as the student will click on OK

If the test assigned to a student presents questions of type Numeric, once the student entered a valid number, the background of the cell become green, otherwise red. If the cell is red, the typed number is not accepted by the browser. **The Teacher (or the Examiner) is warned to check that *the format used for representing numbers is appropriate. Such format, in fact, may vary on different web browsers and lead to wrong outcomes*.** Once completed the test, the student can submit it to the system and the information panel of Figure 20 will appear.
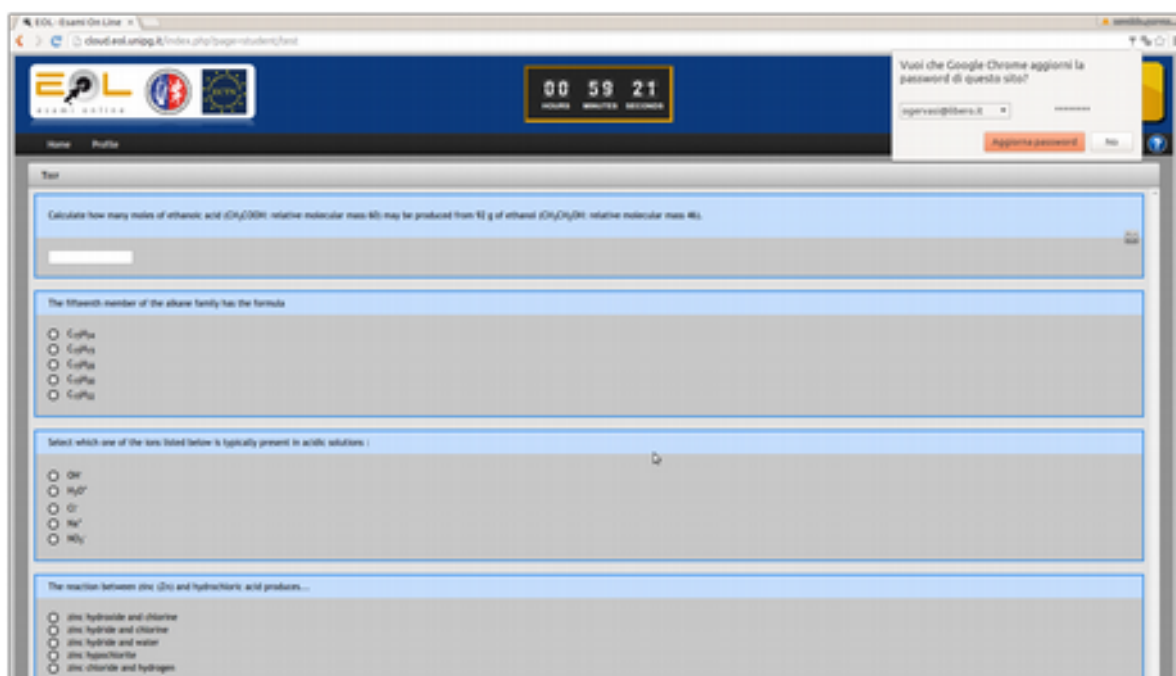
Figure 159: Panel containing the series of questions with related answers

When the student clicks on Yes, the result of the exam is sent to the LibreEOL server and stored in the database. It is also important to notice that, after having received the list of questions and results, the client does not have to change the IP address (otherwise the transmission of results will fail). Examiners and Teachers have to contact the Network Administrator in charge of the configuration of the PC clients to verify that the clients won't change their IP configuration during the session.
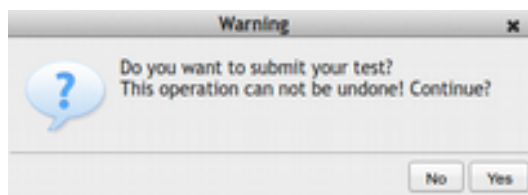
Figure 2016: Panel informing the student about the final, irreversible submission of the test
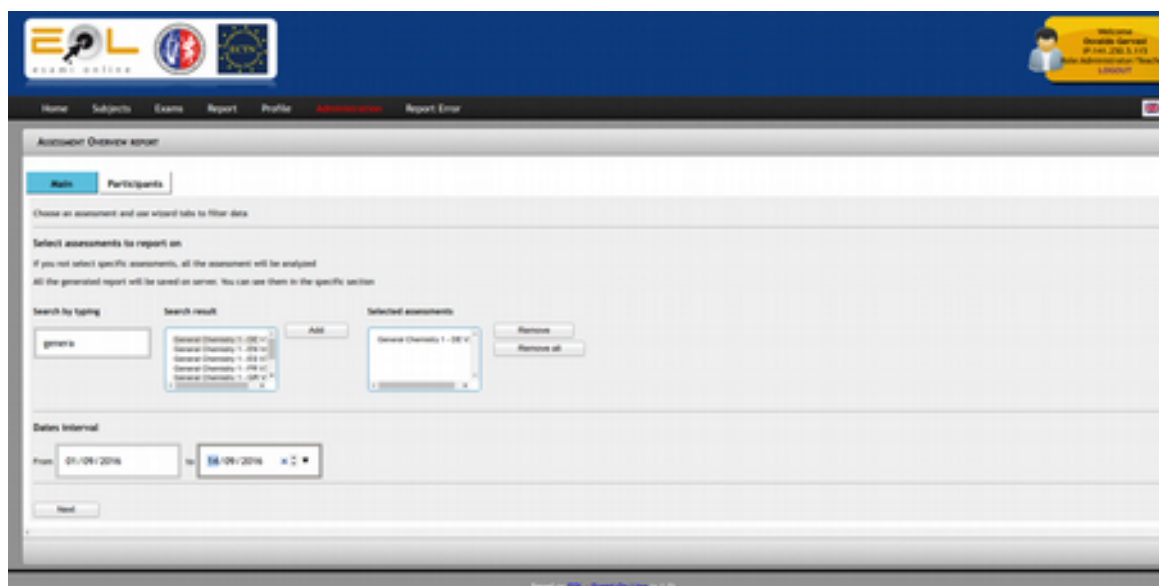
4. Making Reports

Figure 21: Panel for the selection of the report

The Teacher or the Examiner can produce reports on the exams. In particular she/he can produce the *Assessment Overview Report* and the *Coaching Report*.

In Figure 21 the initial window related to the selection of the *Report* panel is shown. Clicking on one of the options the related *Report* is shown. The third option is related to the access to already archived *Reports*.

In Figure 22 the panel related to the *Assessment Overview Report* is shown. One can type a text to restrict the search for specific exams (otherwise all will be listed). Also the date range can be specified in order to reduce the scope of the search.

In Figure 23 the window related to the customization of the report through the selection of the information to be reported is obtained.
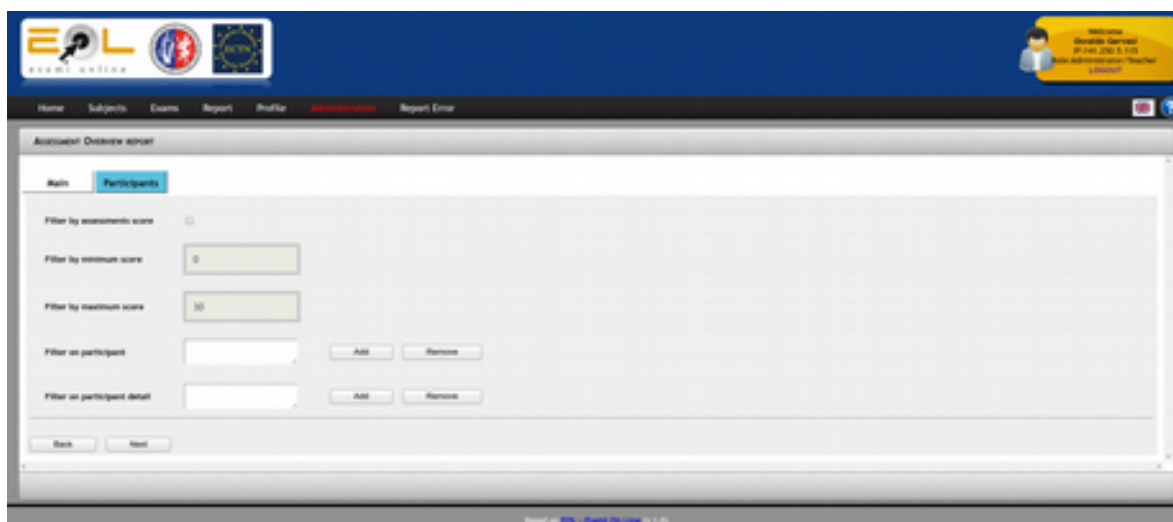
Figure 22: Panel for filtering participants
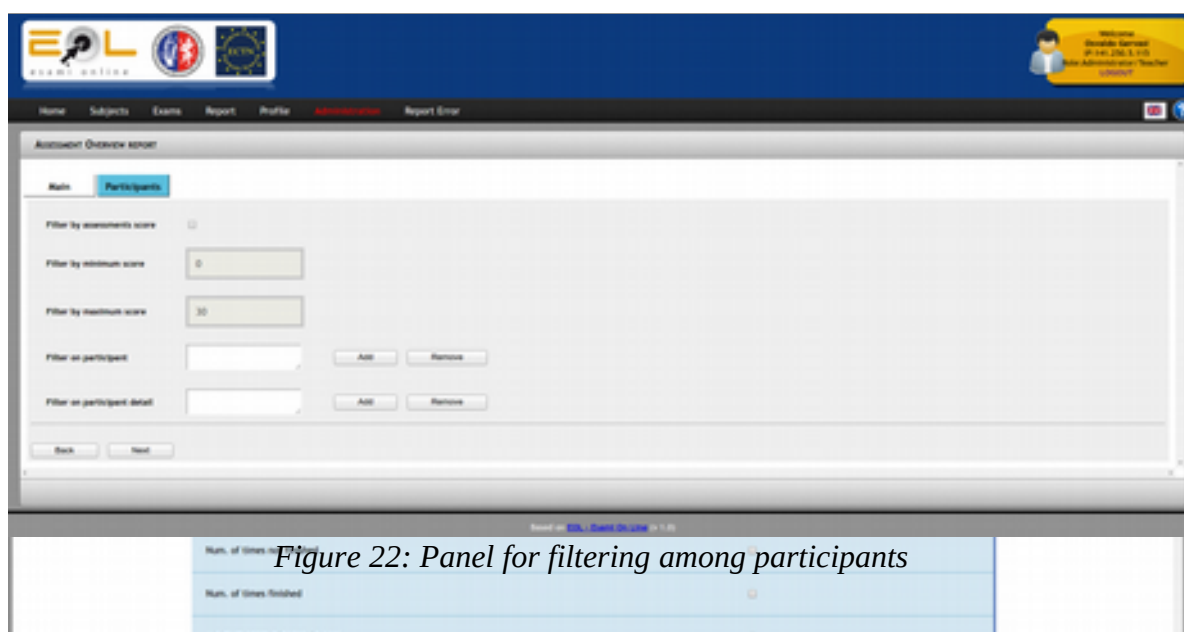
Figure 22: Panel for filtering among participants

Figure 173: Report's Customization Panel

In Figure 24 an example of the *Assessment Overview Report* is shown
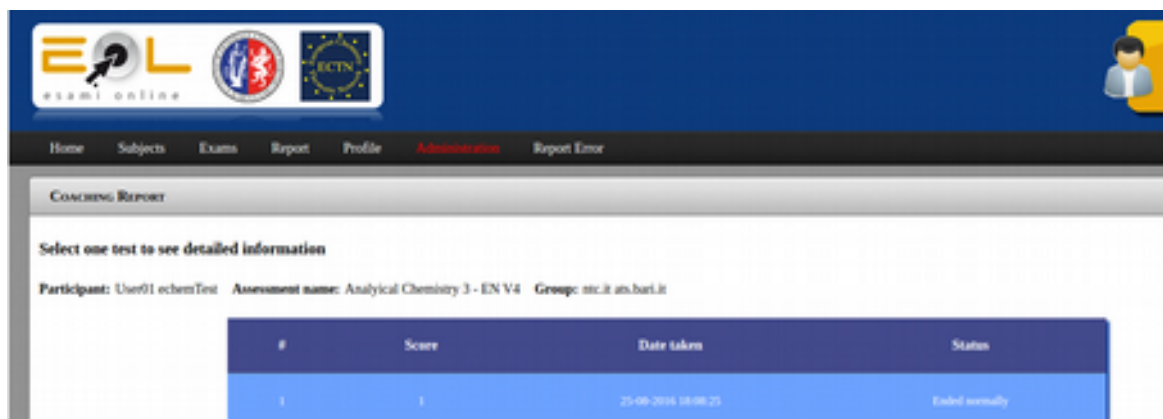
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Figure 195: Panel related to the selection of a discipline and a student for Coaching Report
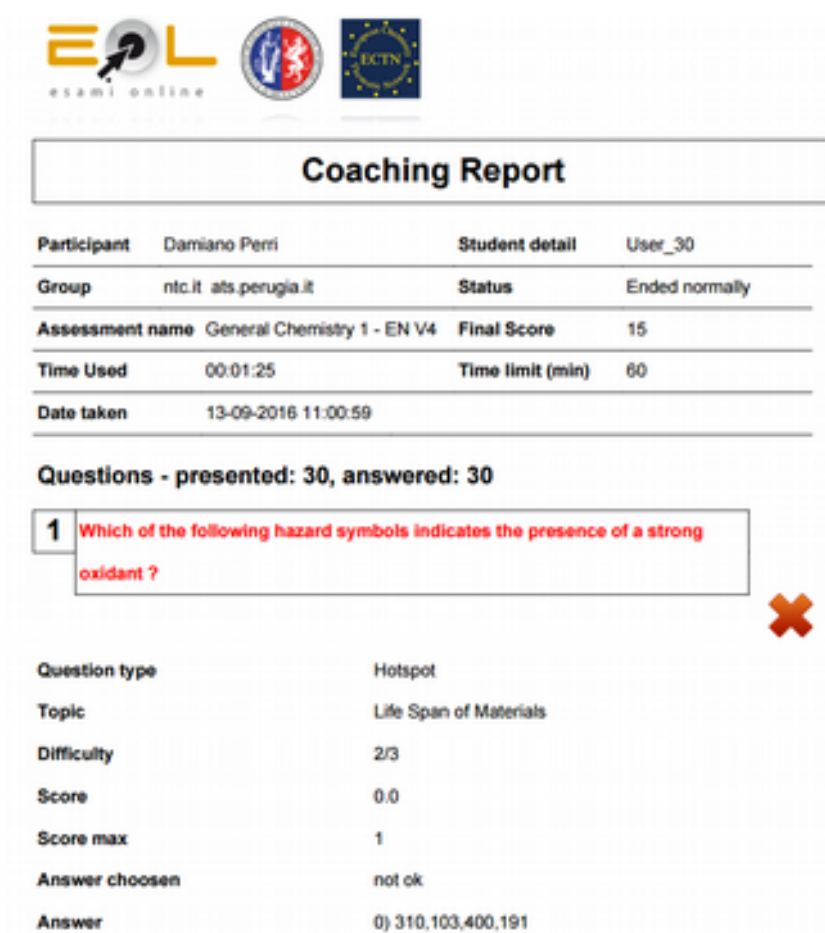
In Figure 25 the panel related to the selection of a discipline and of a *Student* for the production of a *Coaching Report* is shown. In Figure 26 the list of available exams is shown. Selecting one exam the *Coaching Report* will be produced, as shown in Figure 27.

Figure 26: Panel showing the available exams for the Coaching Report

Figure 217: Coaching Report