ECHEMTEST: BACKGROUND AND ACADEMIC/INDIVIDUAL USE

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1. INTRODUCTION

Recently the European Chemistry Thematic Network (ECTN) Association has been paying significant efforts to redesign its web site (the present material has been used to rewrite the web pages of the VIRTUAL EDUCATION COMMUNITY (VEC)). This effort is part of a more general initiative attaining the reorganization of the Association activities after the end of a several years long period of funding from Europe. Within ECTN the role of promoting collaborative Teaching and Learning (T&L) in Chemistry through the use of networking and digital technologies is demanded to the VEC whose activities are managed by the VEC Commission.

The main product of VEC activities is **EChemTest®** a set of electronic Questions and Answers (Q&A)s grouped as Libraries of electronic tests (e-tests) in different subareas of Chemistry knowledge. Such libraries are tailored to fit Schools, University access and graduation European common requirements whose details are given in the **ECHEMTEST** section (also other Libraries have been created either for more general or more professional purposes). Origin, motivations and evolution of **EChemTest®** are illustrated in detail in the **BACKGROUND** section that refers to the series of European Life Long Learning Projects (LLLP)s ECTNx and EC2E2Nx (x= 1, 2, ..) which, during the years 1996-2015, provided financial support to the characterization of both the European common T&L core contents in Chemistry studies and their formulation in terms of Libraries of Q&A e-tests. In September 2015, at the end of EC2E2N2, it became apparent the need for designing a roadmap to sustainability for **EChemTest®**. This prompted the launch, in 2016, of the self-funded ECTN Association project ECHEMTEST+ [1] based on the adoption of the Prosumer (Producer-Consumer) scheme [2].

The funding of the European Commission encouraged more than 100 Departments or HEIs of Chemistry from over 30 countries to collaborate in defining the so called European "Core Chemistry" and then design and develop the relevant full Q&A database and their translations in European languages. This has been made possible by the collaborative effort of hundreds of people who took the time to create, compare, write, check, comment the Q&As and to advice as well the **EChemTest®** work group. Since then hundreds of testing sessions were run allowing a continuous improvement of the quality of the Q&A database.

2. STRUCTURE AND PURPOSE OF EChemTest®

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EChemTest® is the electronic test product developed by the ECTN Association for use to evaluate knowledge and skills in Chemistry by running computer based Self Evaluation Sessions (SES)s articulated in sets of Q&As and organized as Libraries for different levels of Chemistry knowledge. It provides a means for the …

- **Professional worker** seeking for career development and industrial mobility: of progression at work, of self-evaluation for motivation and starting a formal course or taking a national examination;
- **Student** seeking for European Academic Exchange: of evaluation of the chemistry knowledge as well as the understanding of chemistry in a foreign language to undertake a period of study in another country, or to evaluate competence at a European level;
- **Citizen** interested in self-evaluating his/her knowledge in chemistry: to pursue life-long learning.

EChemTest® is a one hour test composed of up to 30 questions of different types, taken at random from a large question bank, covering the Euro-Curriculum Chemistry Program at four different levels equivalent to:

- **Pre-University Level-1:** a person at the end of compulsory education (*General Chemistry 1 (GC1)*);
- **Pre-University Level-2:** a person at the beginning of Chemistry related University studies (*General Chemistry 2 (GC2)*);
- **University Bachelor Level-3:** a person at the end of the Core Chemistry Syllabus at the University Level as defined in the «**Chemistry Eurobachelor®**» (*Analytical Chemistry 3 (AC3)*; *Biological Chemistry 3 (BC3)*; *Chemical Engineering 3 (CE3)*; *Inorganic Chemistry 3 (IC3)*; *Organic Chemistry 3 (OC3)*; *Physical Chemistry 3 (PC3)*);
- **University Master Level-4:** a person at the end of a Master degree in one of the specialized chemistry areas in agreement with the «**Chemistry Euromaster®**» requirement (*Computational Chemistry 4 (CC4)*; *Conservation Science 4 (CS4)*; *Advanced Organic Chemistry 4 (AOC4)*).

EChemTest® examination (the above mentioned Self Evaluation Sessions SESs) is available either in one of the ECTN National Test Centres (TC)s or in the related Accredited Test Sites (ATS)s. These Institutional TCs and ATs are structures managed by Higher Education Institutions (HEI)s or Agencies and are currently indicated as ITCs. All ITCs must have signed with ECTN an ad hoc agreement to run the SESs under controlled conditions. SESs may be conducted by an ITC for its own academic use (S1) or for ECTN itself (S3) (e.g. for testing/validating libraries, EU competitions, national contests) and its Agencies

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or for other ECTN members (whether they are ITC or ATS or not yet authorized TCs which need support from a tutor ITC (usually an NTC) or even for any other cases (like a private company). ITCs must have equipped a their own e-testing infrastructure whose personnel has been trained for that function. In particular, within the Prosumer scheme, **EChemTest®** SESs are operated under the local examiner using the Open Source software LibreEOL (http://echemtest.libreeol.org/doc/ECHEMTestGuide.pdf). LibreEOL is specifically designed for evaluating the knowledge of the candidates by proposing them a randomly selected subset of questions and analysing related answers.

The **academic use of EChemTest®** covers a wide area of T&L academic applications (like evaluating students' dispersion, awarding curricular credits, training on laboratory practice, etc.). The **non-academic use of EChemTest®** covers instead individual and market oriented applications (like building lifelong learning curricula, delivering professional training, issuing Individual Proficiency Certificates (IPC, i.e. the «**ECTN – European Chemistry Certificate**») for international mobility and career advances, etc. Among non-academic activities run by the Agencies are: the organization of commercial events and the issuing upon request of IPCs to candidates successfully passing a SES. If you are not familiar with e-tests, it is strongly recommended before taking any of the official assessments, to train yourself with the ad hoc demonstration tests (please forward the request to http://www.chem-learn.com/demo-libraries-request/).

TCs are increasingly getting involved in designing and implementing educational materials like LOs (Learning Objects), MOOCs (Massive Open Online Courses), audio-visuals and virtual reality applications in order to facilitate the approach to e-tests. **EChemTest®** is an Internet-based service running on several environments such as Windows (Chrome, Firefox) Linux (Chrome, Firefox) and Mac OS X (Chrome, Firefox, Safari) and using Unicode for all non Latin-character based languages (Cyrillic, Greek, Slavic).

Further **EChemTest®** information can be obtained at: contact@echemtest.net.

3. BACKGROUND

The European Commission White Paper on education and training "Teaching and Learning: Towards the Learning Society" which was approved by the Commission in November 1995 had five general objectives, the first of which was to "encourage the acquisition of new knowledge" (objective 1): http://ec.europa.eu/education/doc/official/keydoc/lb-en.pdf.

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The White paper states that a multitude of incentives to learn must be provided, and launched an action concerning the recognition of skills at the European level as one of the ways to provide these incentives. As part of this "Objective 1" of the White Paper, the European Chemistry Thematic Network (ECTN) was awarded a contract for a project entitled "The Evaluation of Core Chemistry".

Project and software tools The chemistry project, one of 16 projects funded by the European Commission, was started in 1996, covering the following periods: 1996-2000 (ECTN1), 2000-2003 (ECTN2), 2003-2006 (ECTN3, "The New Generation of Chemists"), 2006-2009 (ECTN4, "Chemistry in the European Higher Education Area"), 2009-2012 (ECTN5 renamed EC2E2N1 due to the fact that the *Chemistry Thematic* (CT) had been converted into *Chemistry and Chemical Engineering and Education (C2E2)*) and then 2009-2012 (EC2E2N2).

Through the different periods of the project the **EChemTest®** roadmap was articulated as follows:

1. The common content of first degree courses in chemistry (Core Chemistry) in all EU Member States in the Chemistry subareas Physical Chemistry, Organic Chemistry, Inorganic Chemistry, and Analytical Chemistry was identified and formalized in a Syllabus (http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/100)
2. Libraries of Questions and Answers (Q&A) in English for these subareas were designed, implemented and tested to the end of evaluating competence at Bachelor level (level-3) by running Self Evaluations Sessions (SES)s of computer-based tests (e-tests).
3. Libraries have been extended to evaluate competence in Biological Chemistry (level-3) and to General Chemistry (the latter at two levels: a level equivalent to that of a person at the end of compulsory education (level-1), and a level equivalent to that of someone about to commence a university course in chemistry (level-2)).
4. Some of the tests have been translated into different European languages and an extension of the Libraries to Master (level-4) subjects (like Computational Chemistry, Conservation Science and Advanced Organic Chemistry) was also made.

Computer Platform The e-tests were first produced using the commercially available software QuestionMark Designer for Windows and Libraries were distributed by circulating copies on disk. Later the Libraries became available on the net and the sessions were run at the TCs using Internet technologies and the QuestionMark Perception software was adopted (http://www.questionmark.com/). Several types of Q&A formats were available (multiple choice, multiple response, numeric, selection, text, graphical 'hot-spot',

problem solving, etc.) and a detailed analysis of the responses to questions was possible. In order to limit the costs, the Licenses used were of the academic type allowing a limited number of TCs and excluding commercial activities. Further limits of the adopted QuestionMark Perception license were the practical impossibility of exporting the Libraries and the impossibility of influencing the policy of the software producer.

At present, after the end of the EC2E2N2 project as mentioned in the previous section the Open Source LibreEOL software operating on the Cloud has been adopted to conduct the SESs and the already mentioned Prosumer [2] organization has been adopted.

REFERENCES

1] http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/154

2] A. Laganà, O. Gervasi, S. Tasso, D. Perri, F. Franciosa, The ECTN Virtual Education Community prosumer model for promoting and assessing chemical knowledge, Lecture Notes Comput. Science, 10964, xx (2018); DOI10.1007/978-3-319-95174-4_43