

EChemTest® 2021 Accounting - Strategies and Perspectives

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1. Introduction

EChemTest® [1] is the electronic Self Evaluation Session (SES) test service managed by the Virtual Education Community (VEC) of the ECTN [2] Association to the end of evaluating the Chemistry competences of individuals using e-tests based on the Questions and Answers (Q&A) of the Core Chemistry Libraries which are a de facto European standard. EChemTest® SESs are operated by National Test Centres (NTCs, or simply TCs) and their associate Accredited Test Sites (ATs), using a) the on line LibreEOL [3] assessment system running properly selected sets of SESs evaluating the answers provided by the test takers; b) the Chem-Learn [4] portal allowing both the planning and the accounting of the relevant credits/debits of the TC/ATs according to the Prosumer [5] model and the incomes generated by the provision of the EChemTest® SESs to third parties. Here the Chem-Learn innovative features implemented for the year 2021 are illustrated and discussed.

In more detail in the present paper:

section 2 illustrates the annual planning/reporting modules containing, respectively, a) the information to be provided by TC/ATs before starting any credit/debit generating activities and b) the information to be provided at the end of January of next year after checking and closing related activities for VEC approval;

section 3 illustrates the 2021 annual report module for activities having generated incomes either via the issuing of Individual Proficiency Certificates (IPC)s or via the provision of Agency/third party services;

section 4 illustrates the details of the Prosumer model as implemented for the data management of the Chem-Learn portal referring to the year 2021;

section 5 illustrates some relevant financial considerations and perspectives learned from the data processed for the year 2021.

2. Planning/Reporting annual activities

Before starting any activities, each TC/ATs coordinator using his/her own login and password had to submit its annual work plan according to the accepted new guidelines approved by the ECTN General Assembly (GA) of September 2020. The resulting global 2021 work plan is shown in Fig. 1 in which, when more than one ATs operates in the same country, reference is made to the local ATs. Relevant planning data were tentatively input by the AC/ATs coordinators through the "Accounting form" of Fig. 2 in which the different sources of credits/debits are numbered sequentially from Q1 to Q8. In the different columns of Fig. 1 the details of the planned activities are given for the purpose of integrating them within the general plan of ECTN. As a matter of fact, by the decision of the VEC Board and/or of the Administrative Council (AC), concerted actions can

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be promoted out of the TC/ATS proposals and related activities can be centrally prompted and rewarded by assigning credits according to the Prosumer model discussed in some detail in section 4. Accordingly, not only (as apparent from column Q1 of Fig. 1) four TC/ATSs planned by themselves to run more than the first free 100 SESs for their own purposes but also they, as well as other TC/ATSs, ended up to be assigned by the VEC SESs to run on behalf of either another ECTN member (Q2 in which case the other member accumulates the corresponding debit as Q5), or on behalf of ECTN itself (Q3), or of a third party (Q4). Further credits can be earned by a TC/ATS by agreeing with the VEC to create (Q6) or revise/translate (Q7) a certain number of Q&As. Finally further credits (Q8) can be earned by running dissemination activities after agreeing them with the VEC. For example, in this way, as shown in Fig. 1, Budapest booked 150 SES more to be used to run a competition among students of Secondary Schools (Q3) on behalf of ECTN and La Paz booked 30 SES to be used for non ECTN Bolivian Universities (Q4). Fig. 1 shows also that La Paz, Madrid, Kazan and Ljubljana planned for the year 2021 to devote 579, 200, 1 and 20 hours respectively to Q&A Libraries translations and some other hours to dissemination activities. All these activities, once run, would produce credits for the proposing TC/ATS usable to compensate some debits of the Prosumer scheme. In the same way a TC/ATS can produce credits through paid activities for students and third parties.

YEAR: 2021

NTC	ATS	Q1	Q2	Note	Q3	Note	Q4	Note	Q5	Note	Q6	Note	Q7	Note	Q8	Note
ats.genova.it	ats.genova.it	55	0		0		0		0		0				0	
ats.napoli.it	ats.napoli.it	100	0		0		0		0		0				0	
ats.perugia.it	ats.perugia.it	30	0		0		0		0		0				0	
ntc.at	ntc.at	400	0		0		0		0		0				0	
ntc.bl	ntc.bl	100	0		0		30	Bolivian universities	0		0		579	176 AC3, 403 PC3	50	Meetings, presentations in workshops
ntc.hu	ntc.hu	400	0		150	ECTN Secondary school student competition	0		0		0		0		0	
ntc.pl	ntc.pl	150	0		0		0		0		0		0		0	
ntc.ru	ntc.ru	100	0		0		0		0		0		1	Organic and GeneralChem Ru	10	dissemination ECTNA, EChemTest between students
ntc.si	ntc.si	100	0		0		0		0		0		20	GC2 SI V4 (slo/eng que.mix)	0	
ntc.sp	ntc.sp	320	0		0		0		0		0		200	ChemEveryDayLife/General_Chem	10	Meetings for Educational grant application

Fig. 1 - Booking report.

As already mentioned, using the electronic form illustrated in Fig. 2 Chem-Learn was, in a similar way, instructed by the TC/ATS coordinators to record the activities performed (e.g. running SESs (Q1-Q5), creating and/or modifying Q&As (Q6, Q7), spending hours in dissemination activities (Q8)) before starting their 2021 activities. Typically, at the end of each performed activity, the examiner has to input on the Chem-Learn portal (using again his/her own login and password) the actual increment in Q1-Q8.

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Points for the current year	On-line data from EOL Platform	Data for the current year	
Show	View (new tab)	Clear	Edit (new tab)

Activities Report of your NTC/ATS

Date **Month:** **Year:**
 Q2 ▾ 2022 ▾

Q1. Number of own sessions run (total, failed included):	:	<input type="text" value="<number of total sessions>"/>
Q2. Number of sessions run on behalf of other ECTN Members (if any):	:	<input type="text" value="<number of sessions>"/> <input type="text" value="<ECTN member names and/or agreement details>"/>
Q3. Number of sessions run on behalf of ECTN (if any): <small>Note: all the promoted special offers (e.g. school discounts) have to be added here.</small>	:	<input type="text" value="<number of sessions>"/> <input type="text" value="<event titles and/or agreement details>"/>
Q4. Number of sessions run on behalf of an external Institution (if any):	:	<input type="text" value="<number of sessions>"/> <input type="text" value="<external institution names and/or agreement detail>"/>
Q5. Number of sessions run by any other ECTN Member on my behalf (if any):	:	<input type="text" value="<number of sessions>"/> <input type="text" value="<names of hosting TCs and/or agreement details>"/>
Q6. Number of new library questions created (if any):	:	<input type="text" value="<number of questions>"/> <input type="text" value="<agreement details>"/>
Q7. Number of existing library questions revised (if any):	:	<input type="text" value="<number of questions>"/> <input type="text" value="<agreement details>"/>
Q8. Number of hours spent for dissemination activities (if any):	:	<input type="text" value="<number of hours>"/> <input type="text" value="<activity names and/or agreement details>"/>

Add

Fig. 2 - Accounting form.

It is worth mentioning here that, for some contingent reasons, the planning form of Milano was not submitted in due time and that for this reason its plans do not show up in Fig. 1. However, as requested by the ECTN President, the Milano ATS was allowed to carry on its EChemTest® activities (thanks to its excellent past records) and, as we shall comment later in more detail, it ended up by running the largest batch of SESs and a very high level of students' activities.

3. Certificates, Third party activities and Agencies

As already mentioned, an important complement to the credit/debit offsetting mechanism of the Prosumer model is the financial activity related to the issuing of IPCs to the test takers having passed EChemTest® SESs (see Fig. 3 for the IPCs issued by the Italian TC/ATs).

YEAR: **2021**

ATS	Number of Certificates	Library	Registration Date
ats.genova.it	1	pc3	2021-06-25
ats.genova.it	1	oc3	2021-02-06
ats.genova.it	1	gc2	2021-06-24
ats.genova.it	1	ac3	2021-02-06
ats.genova.it	1	gc2	2021-02-06
ats.genova.it	1	ac3	2021-02-01
ats.milano.it	1	oc3	2021-10-15
ats.milano.it	1	gc2	2021-07-28
ats.milano.it	1	pc3	2021-10-08
ats.milano.it	1	ce3	2021-10-15
ats.milano.it	1	gc1	2021-06-30
ats.milano.it	1	gc1	2021-06-20
ats.milano.it	1	oc3	2021-06-12
ats.milano.it	1	ic3	2021-02-19
ats.milano.it	1	pc3	2021-02-19
ats.milano.it	1	oc3	2021-02-19
ats.milano.it	1	gc2	2021-06-19
ats.perugia.it	1	pc3	2021-10-15
ats.perugia.it	1	oc3	2021-09-11
ats.perugia.it	1	oc3	2021-09-09
ats.perugia.it	1	gc1	2021-07-14
ats.perugia.it	6	gc2	2021-07-14
ats.perugia.it	1	pc3	2021-07-01
ats.perugia.it	1	oc3	2021-02-16
TOTAL	24		

Fig.3 - Individual Proficiency Certificates.

Passing a SES in General Chemistry 1 (GC1) is internationally accepted as an adequate proficiency evaluation of Chemistry studies at the level of Upper Secondary Schools (USS) as is passing a SES in General Chemistry 2 (GC2) for access to University Bachelor studies. At the same time passing a SES in Analytical Chemistry 3 (AC3), Biological Chemistry 3 (BC3), Inorganic Chemistry 3 (IC3), Organic Chemistry 3 (OC3), Physical Chemistry 3 (PC3) is internationally accepted as an adequate evaluation for accessing (though not necessarily for being admitted) higher University studies in Chemistry at international level. In Fig. 3 the specific case of the 2021 24 IPCs requested for the

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SEs passed at the three mentioned Italian ATs confirms the high level of interest of the students for such certificates. Of particular interest is the case of Milano that issued 11 IPCs (the maximum number ever issued up to present by a single University for its students). This has occurred also in previous years (and this is most likely why the ECTN President did admit Milano among the ATs active in 2021 even if the annual working plan was not submitted in advance).

It is therefore important for the VEC to be able at any moment to access, trace back and document, through the Chem-Learn portal, the information relevant to the delivered IPCs: where they were issued, which were the libraries accessed and when they were delivered. In order to fully automate the handling of the EChemTest® IPCs (and relevant financial transactions) by the ECTN secretariat it has been already requested the full accessibility by the Chem-Learn Portal to a - listing enabled- web directory (login and password protected) containing all the IPCs produced from past SEs by LibreEOL in the already previously defined format (<yyyymmdd>--<name>--<surname>--<email>--<library>--<ntc>--<ats>.pdf in which all fields delimited by -- are compulsory and do not contain empty spaces with <library> being a string of three characters (e.g. 'gc2'), <ntc> a string like 'ntc.pl', <ats> a string like 'ats.perugia.it' that, if missing, should replicate <ntc>). The relevant procedure is then articulated as follows (with the test taker being allowed to monitor the entire process):

- 1) The test taker in order to search among available certificates is requested to provide all the needed information (evidence of the payment included) in order to generate the corresponding request;
- 2) The ECTN secretariat after qualifying the request as "verified" if this is the case (rollback included), notifies the Chair;
- 3) The ECTN Chair is allowed to sign the request that goes in "ready" (rollback included), and the Chem-Learn Manager (among others, if needed) is notified;
- 4) The Chem-Learn Manager locally archives the IPC, and he/she forwards it (more than once, if needed), adds it to the databases, and assigns relevant credits to the proper beneficiary.

A feature of the adopted Prosumer model of key importance for achieving the EChemTest® sustainability is the possibility of extending its service to USSs, individuals and third parties. In particular, according to the ECTN rules, an individual not belonging to an ECTN University has to contact either the VEC committee (contact@echemtest.net) or an ECTN TC/ATS or a third party having signed the ad hoc MoU enabling it to act as an ECTN Agency. As a matter of fact, since the very beginning of the special ECTN EChemTest+ project launching the Prosumer version of EChemTest® aimed at demonstrating its sustainability, a significant support in this respect was provided by the former spinoff of the University of Perugia MASTER-UP acting as an ECTN Agency⁶. The table given in Fig. 4 shows two particular third party use of EChemTest® during the semester of the year 2021. In the first row is shown the case of two test takers having applied individually to contact@echemtest.net while in the second row is shown the case of six test takers having applied through the Upper Secondary School Istituto Tecnico Industriale (I.T.I.) 'G. Donegani' of Crotona (IT) that, with the patronage of the Education Division of the Italian Chemical Society (SCI), was the first USS to establish a Local ECTN Advisor (LEA) and train six of its students to access EChemTest® SEs and certify their chemistry competences.

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YEAR: 2021

AGENCY	NTC/ATS Referral	SESSIONS	INCOMES (euro)
VEC	ats.perugia.it	2	40
I.T.I. 'G. Donegani' of Crotona (IT)	ats.perugia.it	6	120

Fig.4 – Third party activities

During the 2021 first semester EChemTest® SESs recorded altogether 8 private individual test takers and an income of 480 euro. In the case of third parties, in fact, the test taker pays 60 euro to run through an official TC/ATS a remote SES that can be repeated once for free (if failed the first time). All the eight test takers succeeded in passing the SESs (though 2 of them at the second attempt) and received for free the corresponding IPC. The first line of Fig. 4 shows that, although in both cases the SES were run online on the Perugia ATS, the Agency quota was attributed to the VEC for the two applications handled through contact@echemtest.net and to the Donegani USS for those handled through its LEA. As result the Donegani USS has also expressed its wish to become an Associated Test Institute (ATI) of ECTN.

4. Open Science activities for Chemistry Education

The core mission of the VEC is not just a worldwide diffusion of the EChemTest® online tests on chemistry competences. It is, rather, an attempt to promote more in general an Open Science approach to disseminate chemistry education by involving the ECTN members in its production by generalizing the Prosumer model as commented elsewhere in the present issue. However, in the particular case of EChemTest®, the following scheme is adopted:

- DISSEMINATE worldwide clusters of TC/ATSs acting as academic services providers (e.g., SES management and Q&As development and maintenance) in addition to being the primary users through the debit/credit offsetting mechanism;
- SCALE the present procedures for enlarging the number of ECTN member institutions upon the signature of the relevant MoU;
- FURTHER EXTEND and SIMPLIFY the access to the ECTN services provided to non-academic parties (e.g., individuals, schools, companies, associations) through the creation of more Agencies sustaining financially the various activities of the ECTN Association;
- STRENGTHEN the member activities on producing and maintaining Q&A Libraries, Learning objects, Teaching support materials, Electronic publishing, and Educational multimedia tools;
- SHARE net gains from EChemTest® incomes with ECTN members to promote educational activities in Molecular Sciences.

To support the above mentioned activities in terms of data management, the following relationships have been established:

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- a) EOL to CHEM-LEARN: when one or more exams are archived in EOL, all the relevant data are uploaded to CHEM-LEARN both in order to quantify the number of sessions run per TC/ATS and to distribute them across the Q&A libraries (see Fig. 5);
- b) CHEM-LEARN to EOL: all the approved bookings registered in Chem-Learn are made available to EOL in order to determine if and how many SESs can be activated and run by each TC/ATS;
- c) TC/ATS to CHEM-LEARN: before starting any activities at the TC/ATS at the beginning of a solar year, each TC/ATS has to fill a planning form (to be approved by the VEC Chair) and then within a month after the end of the year (though better by adjourning after each activity is completed) report on the performed activity by specifying the type of sessions run (own sessions, ETCN sessions, sessions run on behalf of other member's or third-party), quantifying the number and type of delivered certificates and other possible tasks (like the creation of new and/or the modification (and translation) of old questions and the activation of dissemination activities);
- d) ECTN/VEC to CHEM-LEARN: at board level, ECTN and/or the VEC Chair, approve bookings, monitor reports and the application of the credit/debit system provided by Chem-Learn. They can also register sessions when acting as an applicant (run own sessions using the facilities offered by a given TC/ATS);
- e) SUPERVISOR to CHEM-LEARN: at supervisor level, in addition to monitor all the running connections, the accounting manager is requested to advertise users for IPCs availability each time a process (a) takes place;
- f) USERS to CHEM-LEARN: a user (either an individual or an institution) can request a specific service (e.g. SESs, production/revision of a new question(s), and run some dissemination activities) to be handled either by a specific TC/ATS, or by an Agency.

Library / TC (2021)	General Chemistry 1 (Total)	General Chemistry 1 (Real)	General Chemistry 2 (Total)	General Chemistry 2 (Real)	Analytical Chemistry 3 (Total)	Analytical Chemistry 3 (Real)	Biological Chemistry 3 (Total)	Biological Chemistry 3 (Real)	Inorganic Chemistry 3 (Total)	Inorganic Chemistry 3 (Real)	Organic Chemistry 3 (Total)	Organic Chemistry 3 (Real)	Physical Chemistry 3 (Total)	Physical Chemistry 3 (Real)	Chemical Engineering 3 (Total)	Chemical Engineering 3 (Real)	Total Sessions Run (2021)	Real Sessions Run (2021)
ats.at	0	0	385	319	0	0	0	0	0	0	0	0	0	0	0	0	385	319
ats.bo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ats.gr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ats.hu	0	0	0	0	107	105	51	51	98	97	82	80	105	100	0	0	443	433
ats.genova.it	0	0	25	25	28	28	0	0	0	0	33	30	26	26	0	0	112	109
ats.milano.it	125	125	118	118	159	154	0	0	156	151	156	148	162	158	77	75	953	929
ats.perugia.it	1	1	9	9	0	0	0	0	0	0	4	4	1	1	0	0	15	15
ats.siena.it	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ats.nl	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ats.pl	0	0	0	0	6	6	1	1	71	71	39	35	3	3	1	1	121	117
ats.ru	41	41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	41	41
ats.si	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ats.sp	164	161	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164	161
TOTAL	331 (14.82%)	328 (15.44%)	537 (24.04%)	471 (22.18%)	300 (13.43%)	293 (13.79%)	52 (2.33%)	52 (2.45%)	325 (14.55%)	319 (15.02%)	314 (14.06%)	297 (13.98%)	297 (13.29%)	288 (13.56%)	78 (3.49%)	76 (3.58%)	2234	2124
ERRORS	3 (0.91%)		66 (12.29%)		7 (2.33%)		0 (0%)		6 (1.85%)		17 (5.41%)		9 (3.03%)		2 (2.56%)		110 (4.92%)	

Fig.5 - Data Management.

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5. Final financial considerations and conclusions

The 2021 debit/credit balance confirms the EChemTest® sustainability and shows that the cost of Chem-Learn and LibreEOL services are fully covered by the revenues of the present ECTN TC/ATS activities.

The model relies on the fact that, within the adopted Prosumer model the same subject may act, as already pointed out before, both as producer and consumer. Within such scheme, the ECTN Association (the owner of EChemTest® and of the relevant intellectual properties of the used products) was managing, either directly or indirectly, the financial activities by collecting the relevant incomes and paying for the relevant expenses.

The financial balance resulting from the Chem-Learn data correlation scheme described above for the year 2021 is shown in Fig. 6. It clearly confirms the sustainability of the regime introduced by the new the EChemTest® MoU while paving the way for assigning incentives from ECTN resources for the most active and successful parties.

YEAR: **2021**

NTC/ATS	CREDITS (euro)	DEBITS (euro)	IPC (euro)	THIRD- PARTY (euro)	PROMO FUND to be redistributed and not added to the TOTAL (euro)	TOTAL (euro)
VEC	0	0	293.33	160.00	160.00	453.33
ntc.at	0	997.5	0.00	0.00	not applicable	-997.5
ntc.bl	437.5	0	0.00	0.00	not applicable	0
ntc.gr	0	0	0.00	0.00	not applicable	0
ntc.hu	0	1200.5	0.00	0.00	not applicable	-1200.5
ats.genova.it	0	42	80.00	0.00	not applicable	38
ats.milano.it	0	2985.5	146.67	0.00	not applicable	-2838.83
ats.perugia.it	0	0	66.67	160.00	not applicable	226.67
ats.napoli.it	0	0	0.00	0.00	not applicable	0
ntc.nl	0	0	0.00	0.00	not applicable	0
ntc.pl	0	73.5	0.00	0.00	not applicable	-73.5
ntc.ru	0	0	0.00	0.00	not applicable	0
ntc.si	17.5	0	0.00	0.00	not applicable	0
ntc.sp	0	224	0.00	0.00	not applicable	-224
BALANCE	455	5523	586.67	320	160.00	5522.99

Fig.6 - Financial table

(please notice that the debit of Budapest - ntc.hu - for more than 400 SESs has been paid in advance).

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The above made considerations allow us to conclude that the introduction of a fully automated administrative process for establishing a sustainable delivery of IPCs will allow a successful centralization of the relevant administrative processes at the ECTN secretariat level. The mechanism will be based on the fact that the Chem-Learn Portal will communicate with EOL containing all the IPCs produced from past SESs by a well-defined and secure protocol. This will increasingly help: a) the test taker in providing the needed information (evidence of the payment included) and in monitoring the progress of his/her IPC request, b) ECTN in qualifying the request as “verified” (rollback included) and notifying the Chair, c) the VEC Chair in signing the IPCs and putting the request in “ready” (rollback included), d) the TC/ATS Manager in repeatedly forwarding the IPC, e) the Secretariat in completing the administrative procedures and add the IPC to its official database. A final important advantage of the new procedure is the possibility of involving in the process the USS and assign them the relevant credits.

6. References

- [1] <http://ectn.eu/committees/virtual-education-community/echemtest>
- [2] <http://www.ectn.eu>
- [3] <https://echemtest.libreeol.org>
- [4] <https://www.chem-learn.com>
- [5] 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 Computer Science* 10964, 533-548 (2018)
- [6] A. Laganà, Towards a worldwide EChemTest® service, *Virt&l Comm*, 22, 2 (2021), <http://services.chm.unipg.it/ojs/index.php/virtlcomm/article/view/257>